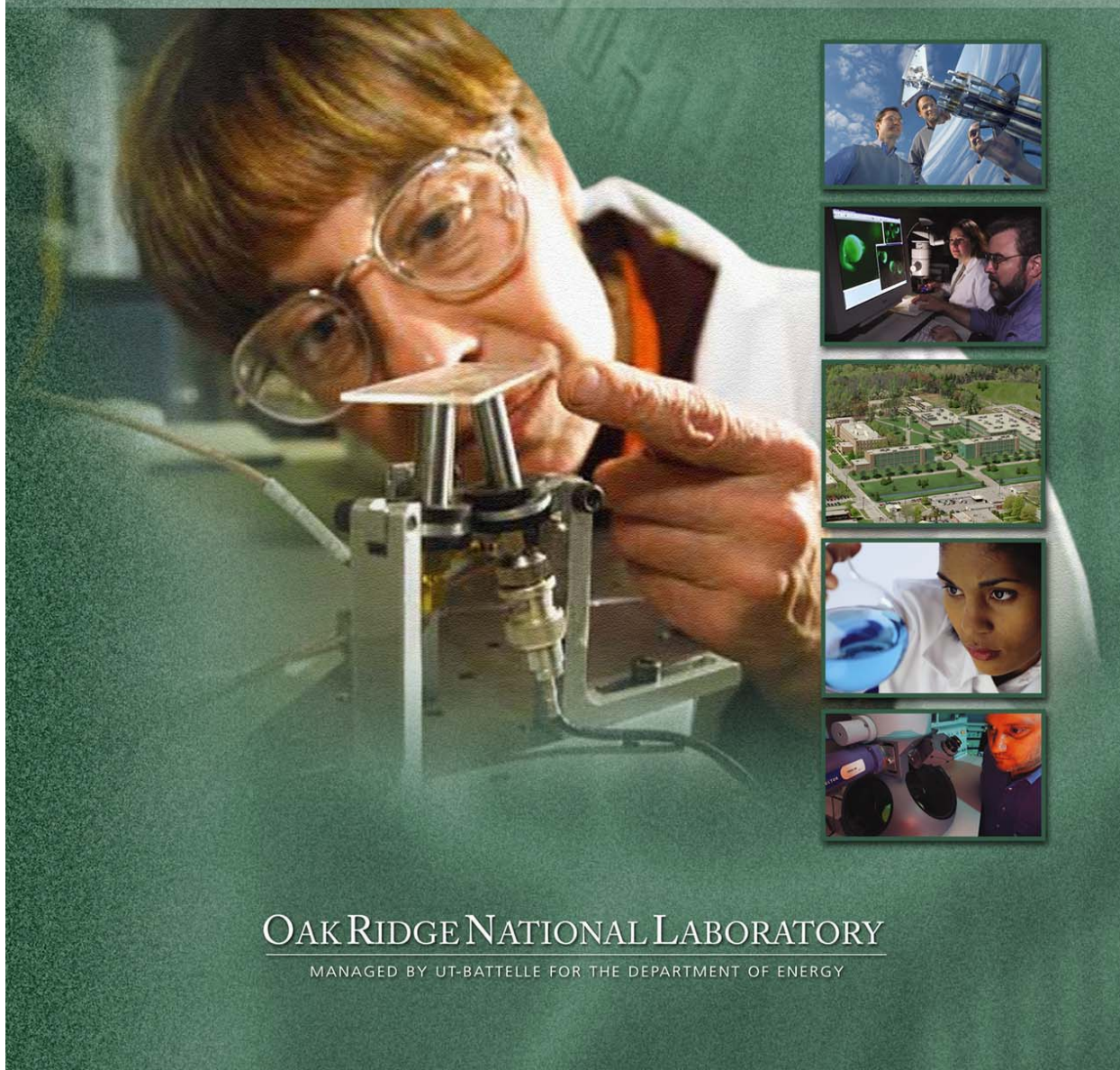


FY 2004

ANNUAL SELF-EVALUATION

Report



OAK RIDGE NATIONAL LABORATORY

MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

OAK RIDGE NATIONAL LABORATORY

MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

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October 26, 2004

Mr. George J. Malosh
ORNL Site Manager
Department of Energy
Oak Ridge National Laboratory
Post Office Box 2008
Oak Ridge, Tennessee 37831-6269

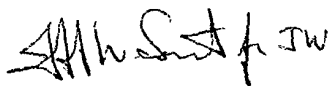
Dear Mr. Malosh:

Contract DE-AC05-00OR22725, Oak Ridge National Laboratory's (ORNL) Self-Evaluation Report

Attached is a copy of ORNL's Self-Evaluation Report for the period from October 1, 2003, through September 30, 2004. The report chronicles an outstanding year in support of the Department of Energy's missions. The quality of our scientific agenda brought us major victories in the areas of nanoscience, genomics, and computational science. The Laboratory's modernization efforts moved from plans to reality as we moved into our new, pathogen-free Laboratory for Comparative and Functional Genomics. As a result of our outreach efforts, ORNL is viewed by the community as the region's premier supporter of math and science education. Perhaps most significant, we continued on time and on budget with the construction of the Spallation Neutron Source.

As you review the report, I encourage you to examine the scope of our progress over the last twelve months. Our commitment is to sustain this momentum in the coming year. If you have any questions, please contact Kelly Beierschmitt at 241-7600.

Sincerely,



Jeffrey Wadsworth
Director

JW:ajd

Attachment

Mr. George J. Malosh
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October 26, 2004

Distribution

c/att: F. L. Ginn, DOE-ORO
D. E. Gound, DOE-ORO
Leadership Team
Level 2 Managers
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File—RC

FY 2004

Self-Evaluation Report

of the

Oak Ridge National Laboratory

October 26, 2004

EXECUTIVE SUMMARY

OVERVIEW

During fiscal year (FY) 2004, Oak Ridge National Laboratory (ORNL) made substantial progress toward its strategic objectives of excellence in science and technology; excellence in Laboratory operations and environment, safety, and health (ES&H); and excellence in community service. Overall, on the basis of the evidence contained in this self-evaluation report, we conclude that the Laboratory's performance during the FY 2004 evaluation period has been "Outstanding."



This conclusion is based in large part on our self-evaluation against the measures and indicators documented in the FY 2004 Performance Evaluation Plan (PEP). The PEP, developed in partnership with our Department of Energy (DOE) customers, is the primary means by which our performance rating is determined.

While the PEP provides a useful means of assessing ORNL's FY 2004 performance, we also find it valuable to look beyond the PEP to gain a full understanding of ORNL's efforts to meet or exceed our customers' needs and expectations.

This year, for example, we continued to deliver outstanding performance for science and technology. ORNL staff

- led the effort to reshape the nation's high-end computing and successfully competed for the opportunity to build the National Leadership Computing Facility, which will deliver ultrascale computing capability for scientific research and revitalize the U.S. effort in high-end computing;
- partnered with the Princeton Plasma Physics Laboratory to develop the winning proposal to host the U.S. International Thermonuclear Experimental Reactor (ITER) Project Office, supporting the top-priority project in DOE's 20-year facilities plan;
- set a new world record for high-resolution microscopy, using an aberration-corrected electron microscope to deliver a direct image of silicon atoms with a resolution of 0.6 Å; and
- earned recognition for their accomplishments with three awards in the R&D 100 competition, four awards from the Federal Laboratory Consortium for Technology Transfer, and the election of a senior ORNL researcher to the National Academy of Engineering.

We continued our dramatic progress on our \$300 million modernization project. During this past year, ORNL saw the completion of several new scientific facilities that have fundamentally changed the laboratory, rapidly bringing it into the 21st century.

- The Russell Laboratory for Comparative and Functional Genomics completed its first year of operation with the reconstitution of 55 strains of mice from cryogenically preserved stocks. The Russell Laboratory project team received DOE's Acquisition Improvement Award with a citation stating that the facility was completed on time at a cost saving of \$380,000.
- The \$10 million facility housing the Joint Institute for Computational Sciences and the Oak Ridge Center for Advanced Studies, constructed with funding from the state of Tennessee, was dedicated in May 2004.
- The new Advanced Microscopy Laboratory (AML), designed to meet the demanding requirements of high-resolution microscopes, was completed.
- A Multiprogram High Bay Facility has been completed in the 7600 Area, providing space for magnetic fusion experiments and supporting the relocation of ORNL staff from Y-12 to ORNL.

We delivered substantial progress on other construction projects that will continue the transformation of the Laboratory:

- The construction project for the Spallation Neutron Source (SNS) is the Office of Science's largest, most complex project and we have managed that project with distinction. It remains on time, on budget, and with an exemplary safety record.
- DOE's first Nanoscale Sciences Research Center, the 80,000-square-foot Center for Nanophase Materials Sciences (CNMS), is also under construction on Chestnut Ridge; this \$65 million project is on schedule and on budget.
- The Research Support Center, which will provide ORNL staff with a new cafeteria, conference facilities, and a dedicated visitor center, is on schedule for FY 2005 completion.

In addition to building new facilities, we continued to invest in renovation and upgrades of existing facilities. We met new expectations, set by the Office of Science, for maintenance investment. ORNL exceeded both the FY 2004 target of 1.4% and the FY 2005 target of 2.0% for Real Property Asset Management maintenance investment by achieving an investment index of 2.6%.

Our safety performance, while still having room for improvement, has truly changed for the better at a tremendous pace; fewer workers are getting hurt than at any other time in history. Our intense focus on improving safety performance and operational discipline throughout ORNL also extends beyond the measures of the PEP, as indicated by the following accomplishments.

- A Laboratory Space Manager Program was implemented to ensure that the hazards of activities and operations in laboratories and experimental spaces at ORNL are identified and controlled and that the space is maintained in a clean and orderly manner.
- ORNL obtained ISO 14001 registration of its Environmental Management System, providing external validation of the effectiveness of this system.
- The ORNL Metrology Laboratory completed all requirements for accreditation to the two national standards for calibration laboratories (ISO/IEC 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*, and the more rigorous ANSI/NCSL Z540-1-1994, *Calibration Laboratories and Measuring and Test Equipment—General Requirements*) by the National Voluntary Laboratory Accreditation Program.

Our considerable improvements were recognized by a team from the Office of Environment, Safety and Health Evaluations in DOE's Office of Independent Oversight and Performance Assurance while assessing ORNL's implementation of Integrated Safety Management. The team noted with approval the "major sea change" in the Laboratory's safety culture since 2001. Our final injury rate for FY 2004 represents a 26% improvement compared to the previous year; the days away, restricted, or transferred (DART) rate of 0.5 is well below the FY 2003 result of 0.8.

Our sense of accomplishment is tempered by our concern about three operational events that occurred during the year.

- In October 2003, a low-level liquid waste (LLLW) spill occurred in Building 2026. While the direct cause of the event was a partially blocked drain line, the root cause was determined to be management's tolerance for a culture in which degraded equipment performance was known and accepted without investigation or correction.
- As the inner shroud was being removed from the reactor during defueling operations at the High Flux Isotope Reactor (HFIR) in January 2004, it slipped from the lifting mechanism and fell approximately four feet. Investigation of this incident revealed that required maintenance inspections had not been conducted as scheduled.
- The most disturbing event occurred in March 2004, when an out-of-service hoist was being removed from Building 7930. The hoist fell 12 feet into a confined space. Although no one was injured, this

near-miss incident provided sobering evidence that the work plan for this task did not adequately identify and mitigate hazards.

We have taken aggressive actions to correct the conditions that led to each of these events. These actions are part of our continuing efforts to improve the safety, discipline, and integration of ORNL's operations—efforts that are constrained by the lack of funding for renewal of critical facilities but are, in our view, having a noticeable impact on our safety performance and conduct of operations.

To communicate senior management's safety expectations to ORNL employees, the Laboratory Director began a series of "rolling safety stand-downs" in August 2004. By mid-October 2004, these meetings will have given all ORNL employees the opportunity to hear the Laboratory's senior managers discuss their personal involvement in and commitment to safety and operational discipline.

Despite a strong management focus on increasing the diversity of ORNL staff, we fell short of our objectives in this area. A new emphasis on management accountability produced positive indications of improvement by year's end. We have developed a Laboratory-wide workforce forecast and a comprehensive workforce plan with a strong focus on recruitment.

As part of our outstanding support of the community, we led the effort to rebuild the Oak Ridge High School, a school with one of the best academic records in Tennessee, but operating with a fifty-year-old infrastructure. Our involvement with stakeholders, our community outreach projects, including the Oak Ridge Rowing Association and the Oak Ridge Civic Arts Council, and our Team UT-Battelle activities are unparalleled.

On balance, we believe that our overall performance in FY 2004, evaluated against the PEP and the other information presented in this report, was indeed outstanding.

PERFORMANCE HIGHLIGHTS

Strategic Objective 1: Science and Technology

Our self-evaluation of ORNL's FY 2004 performance in science and technology yields a rating of "Outstanding." The following discussion highlights the achievements delivered to ORNL's primary DOE programmatic customers. Key issues raised by customers are also addressed.

Office of Science: Office of Basic Energy Sciences

The SNS, the nation's largest civilian science project, remained on budget and ahead of schedule; the project was 87% complete at year's end and remains on track to deliver a facility that meets approved project requirements by the scheduled completion date of June 2006. Outstanding progress in facility construction was complemented by the installation and commissioning of technical components as the project begins the transition to operations. The SNS project met or exceeded all technical, cost, and schedule requirements and maintained an exemplary safety record, completing more than 3.1 million hours of construction work with only one lost work day and no environmental concerns.

Substantial progress was made in upgrades of the HFIR, including the installation of four additional neutron scattering instruments that provide world-class capabilities for materials research. A new executive director was hired, and the HFIR completed its 400th fuel cycle in May 2004.

The \$65 million CNMS, under construction on Chestnut Ridge near the SNS, is the first of five Nanoscale Sciences Research Centers that the Office of Basic Energy Sciences (BES) is building to serve as the Nation's premier user centers for interdisciplinary research at the nanoscale. The CNMS provides the basis for a national program that is focusing ORNL's new science, new tools, and new computing capabilities on the synthesis, characterization, theory/modeling/simulation, and design of nanoscale materials. The CNMS is already operating as a user facility with 42 active projects that make use of existing facilities at ORNL.

The new AML, which provides the environment that ORNL's high-resolution electron microscopes need in order to deliver the best possible performance, was completed in April 2004. This facility extends the capabilities of our present subangstrom-resolution instruments and supports the new aberration-corrected electron microscope (ACEM), which has been installed in the AML.

Using an existing subangstrom-resolution microscope, ORNL established a new world record in electron microscope imaging in April 2004. A direct image of a silicon crystal with a resolution of 0.6 Å was achieved. With this new technique, individual atoms can be located in three dimensions, opening a path to three-dimensional imaging of materials at the atomic level. These advances will enable atom-by-atom characterization of materials, providing new understanding of their properties and the potential for advances in chemical sciences, structural materials, electronic materials, biosciences, nanoscience, and other fields.

Other notable accomplishments in the physical sciences include the following:

- In February 2004, C.T. Liu, ORNL Metals and Ceramics Division, was elected to the National Academy of Engineering.
- Jian Shen, ORNL Condensed Matter Sciences Division, was honored with the Presidential Early Career Award for Scientists and Engineers for his work on magnetism in nanostructured materials.
- Two R&D 100 awards for the Advanced Heating System for High-Performance Aluminum Forgings and the Highly Selective, Regenerable Perchlorate Treatment System.
- Elbio Dagotto, formerly of the National High Magnetic Field Laboratory at Florida State University, was named an ORNL–University of Tennessee Distinguished Scientist.
- Laetitia Delmau received a *Technology Review* TR100 Young Innovator Award.

Office of Science: Office of Biological and Environmental Research

The new William L. and Liane B. Russell Laboratory for Comparative and Functional Genomics, located on the west campus of ORNL, began operations in October 2003, with the first litter of mice pups from frozen embryos born in March 2004. The Russell Laboratory project team received the Acquisition Improvement Award from DOE; the award citation noted that the facility was completed on time at a cost saving of \$380,000. The facility is being operated by a private contractor. By year's end, ORNL had rederived 51 lines of mice from cryogenically preserved stocks, exceeding the PEP goal of 35. Funding for construction of a facility to house the Joint Institute for Biological Sciences near the Russell Laboratory is included in the State of Tennessee budget for this year.

ORNL delivered outstanding performance in meeting milestones for the ongoing Genomics: GTL project. The Laboratory Information Management System (LIMS) has been implemented, a production "pipeline" for the identification and characterization of protein complexes is in operation, and work to explore the use of electron microscopy as an imaging tool is in progress.

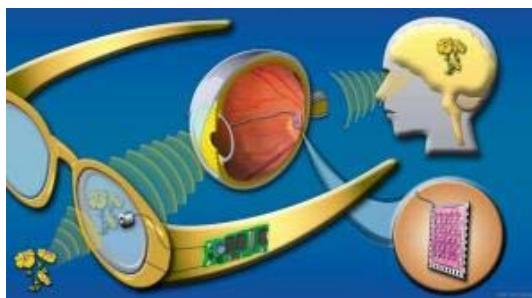
ORNL researchers contributed to the delivery of the genome of *Rhodospseudomonas palustris*, a photosynthetic bacterium with diverse metabolic capabilities that is the subject of several large research projects sponsored by DOE's Office of Science as part of the Genomics: GTL program. This work was featured on the cover of *Nature Biotechnology*.

The *Populus* genome (the first tree genome to be sequenced and annotated) was released to the public in September 2004, providing the research community with a model plant genome to understand plant-based processes that influence carbon sequestration, phytoremediation, and bio-based products such as ethanol. The book *Microbial Functional Genomics*, written by ORNL researchers with colleagues at the University of Georgia and Michigan State University, was published in April 2004. As the first comprehensive treatment of this subject, the book provides a timely synthesis and summary of the principles, approaches, and applications of microbial functional genomics.

ORNL scientists won the Outstanding Paper in Landscape Ecology Award from the International Association of Landscape Ecology for their new statistical tool, the Fractal Landscape Realizer that generates synthetic multiple-category landscape maps to users' specifications.

Research on fine root production and mortality in a sweetgum forest exposed to elevated CO₂ was published in the *Proceedings of the National Academy of Sciences*. The large increase in root production reported in this work has implications for carbon sequestration and for nitrogen and water uptake.

ORNL delivered outstanding leadership of the artificial retina project, a multi-institutional project that combines funding from DOE, the National Institutes of Health (NIH), and the National Science Foundation (NSF). ORNL researchers also contributed a significant research finding by demonstrating that light-absorbing pigments from spinach can be added to human nerve cells in the retina and cause these cells to fire when struck by light.



Artificial Retina: A tiny camera is embedded in the glasses lens. Images are sent to a micro-processor which converts the data to an electronic signal. An antenna in the lens transmits the signal to a receiving antenna in the eye. The signal then travels along a tiny wire to the retinal implant and signal causes the implant to stimulate the remaining retinal cells. These cells send the image along the optic nerve to the brain.

A microcantilever sensor system with unprecedented sensitivity and selectivity was designed and developed, opening the way to miniaturization far beyond what is achievable today. This system serves as the basis for a handheld explosive detection device that was selected for a 2004 R&D 100 Award.

Two ORNL proposals received "\$1,000 Genome" grants from the NIH National Human Genome Research Institute (NHGRI). The projects will be part of a program to accelerate the development of innovative technologies that will dramatically reduce the cost of sequencing whole genomes.

Office of Science: Office of Advanced Scientific Computing Research

ORNL demonstrated leadership in high-performance computing by enhancing the accessibility of high-performance computing capability, both within the Laboratory and for our external partners during FY 2004:

- In May 2004, the Secretary of Energy announced that a team led by ORNL had been selected to build the National Leadership Computing Facility to deliver ultrascale computing capability for scientific research and revitalize the U.S. effort in high-end computing, with the goal of providing

a supercomputer capable of a sustained performance of 100 trillion operations per second (teraflops) by 2007.

- A facility housing the Joint Institute for Computational Sciences and the Oak Ridge Center for Advanced Studies, funded by the State of Tennessee, was dedicated in May 2004.
- ORNL successfully completed its evaluation of the Cray X1 supercomputer, exceeding the demanding requirements specified for the evaluation and showing that this architecture is exceptionally fast for a number of applications (e.g., 50% higher simulation throughput for global ocean simulation than on the Japanese Earth Simulator for the same number of processors). “Proof-of-principle” computations were performed for fusion simulations and materials science. The Cray system was expanded from 128 to 256 processors, and the collaboration between ORNL and Cray has been expanded to test scalability and the operating system.
- Through the Center for Computational Sciences (CCS), ORNL provided support to the International Panel on Climate Change (IPCC), performing simulations with the Community Climate System Model in a high-resolution configuration. A memorandum of agreement with the National Center for Atmospheric Research expands a longstanding partnership and supports the upcoming IPCC Fourth Assessment.
- ORNL enhanced the accessibility of its computational resources through partnerships. A memorandum of understanding with National LambdaRail supports the development of a fiber-based infrastructure for performing computational science and sharing the massive data that result across next-generation networks. A partnership with the Tennessee Valley Authority (TVA) takes advantage of idle TVA resources to provide high-speed access to ORNL resources to the University of Tennessee, Vanderbilt University, and other schools and research institutes in the TVA service area. ORNL and the UT-Battelle partner universities are linking ORNL’s neutron sciences facilities to the NSF TeraGrid. ORNL’s design of the backbone for the Ultrascale Science Research Network has been completed and has attracted considerable attention and the authors have given invited papers.
- SciDAC runs using ORNL resources resulted in a number of scientific advances in areas including climate prediction, supernova simulations, superconducting materials modeling, and fusion simulations. A peer review of the SciDAC Climate Consortium, held October 2003, was very favorable with recognition that this capability is becoming a national asset.
- In collaboration with Silicon Graphics, Inc. (SGI), the CCS evaluated a 256-processor Altix system with 2 terabytes of shared memory to assess the suitability of this system for use in scientific processing for DOE’s Office of Science.
- ORNL was the first DOE laboratory to begin evaluation of IBM’s third-generation interconnect technology on the CCS IBM Power4 Cheetah machine. IBM plans to use this Federation interconnect on its Power5 supercomputer, which is now under development.



Signing ceremony for TVA/ORNL high-speed research network agreement. From left to right: ORNL Director Jeff Wadsworth; Gerald Boyd, Manager of DOE’s Oak Ridge Operations; TVA Director Bill Baxter; Raymond Orbach, Director of the DOE Office of Science; U.S. Representative Zach Wamp; and Undersecretary Phillip Bond, U.S. Department of Commerce.

Office of Science: Office of Fusion Energy Sciences

The proposed Quasi-Poloidal Stellarator (QPS), an innovative configuration developed at ORNL, received Critical Decision 1 (CD-1) approval on June 11, 2004. In August 2004, a contract was awarded

for fabrication of a complex stainless steel form on which a prototype QPS coil will be wound in FY 2005.

Irradiation tests were conducted in HFIR to evaluate the effects of neutron bombardment on the microstructural evolution and properties of leading candidate fusion materials.

ORNL further demonstrated its continuing leadership in fusion energy sciences during FY 2004:

- ORNL and the Princeton Plasma Physics Laboratory have been selected to host the U.S. ITER Project Office, supporting the ITER project. ITER is identified as the top priority in DOE's 20-year science facilities plan [*Facilities for the Future of Science: A Twenty-Year Outlook* (DOE/SC-0078, revised in December 2003)].
- At the Multicharged Ion Research Facility, Physics Division scientists made the first measurements of fragmentation products in chemical sputtering of graphite by hydrogen molecular ion impact. This work is of immediate relevance to the erosion of plasma-facing components in present and next-step fusion energy devices, such as ITER.

Office of Science: Office of Nuclear Physics

The Fundamental Neutron Physics Beamline for the SNS achieved CD-1 approval in March 2004. This \$9.2 million facility will enable scientists to conduct experiments on important questions in nuclear physics, particle physics, and astrophysics.

The Holifield Radioactive Ion Beam Facility (HRIBF) achieved its beam delivery goals for the year, with more than 1500 hours of radioactive ion beams (RIBs) delivered to experiments as part of an overall operation total of more than 4000 hours.

Physics Division researchers collaborating with Michigan State University successfully developed an implementation of coupled-cluster techniques to nuclear structure. This development is important for the theoretical description of nuclei produced at HRIBF.

A workshop on in-beam gamma-ray spectroscopy was held in April 2004 to bring together those interested in doing in-beam gamma-ray experiments at the HRIBF, to acquaint them with HRIBF capabilities for such experiments, and to address the facility's need to map out its gamma-ray detector requirements for the rest of the decade.

Jeff Blackmon, Physics Division, received the Presidential Early Career Award for Scientists and Engineers on May 4, 2004, at a White House ceremony. The award recognized his pioneering work with radioactive ion beams to understand stellar explosions.

Office of Energy Efficiency and Renewable Energy

Benchmark testing of a Capstone 30-kW microturbine generator in a combined heating and power (CHP) system at the ORNL Cooling, Heating, and Power Integration Laboratory User Center has been completed, and test data were used to develop and validate a computer algorithm for optimizing system performance. A modular, integrated CHP system with a capacity of 4.6 MW was placed in operation in Austin, Texas. The system, which was developed by ORNL and industry partners, is expected to be at least 60% efficient, providing electricity to the grid and cooling to a high-tech industrial park.

Industrial-scale heats of new nanostructured reinforced steels, developed at ORNL, were thermomechanically processed into slab, plates, forgings, and tubing. Mechanical testing of these components demonstrates that these new alloys can be successfully processed into various product forms with existing commercial equipment and that their properties surpass those of commercially available alloys.

ORNL expanded its collaborations with industrial partners for manufacturing and testing of nitride metallic bipolar plates for fuel cells. Haynes International and Allegheny Ludlum provided ORNL with sheets of commercially available Ni-Cr and stainless steel alloys for rolling/stamping and nitridation evaluation and fabrication of fuel cell plates. Tests at ORNL show that these materials have good corrosion resistance and electrical properties. ORNL also manufactured plates of nitrided Ni-50Cr model material and delivered them to three industrial partners for fuel cell testing.

An order was placed for a next-generation Programmable Powdered Preform Process (P4) machine, which will be used for developmental research on the use of carbon-fiber composites for automotive body components. The equipment will also serve as a base system in which next-generation chopper gun developments (for example, for hybrid glass-carbon fiber and reinforced thermoplastic fiber preforms) will be researched and demonstrated for transfer to industry. These developments will increase the mass savings potential, cost effectiveness, and potentially the recyclability of the resulting structures.

An Electric Transmission and Distribution Technologies Program was established at ORNL, comprising tests of advanced conductors at the Powerline Conductor Accelerated Testing (PCAT) facility and work to develop superconducting power cables, communication and control technologies, power electronics, and tools for improving efficiency and load management. The PCAT facility was used for tests of a new Southwire overhead conductor with embedded optical fibers, which enable monitoring of conductor temperature on critical transmission spans. ORNL and SuperPower executed a new Cooperative Research and Development Agreement (CRADA) in July to jointly develop key aspects of transmission-level fault current-limiting technology.

Office of Fossil Energy

An inorganic hydrogen separation membrane prototype was submitted to DOE for classification and nonproliferation reviews. The membranes were determined to be unclassified and were approved for extended unclassified development and demonstration on July 9, 2004.

ORNL completed the development of its electromagnetic acoustic transducer in-line pipe inspection tool and made it available to the National Energy Technology Laboratory.

A topical report on the synergies between aromatic compound formation and/or mitigation and the removal of sulfur and other heteroatoms was prepared to aid refiners in the development of strategies to enhance the hydrogenation capabilities of their existing refinery processes. These new strategies will be required to meet, for example, new EPA diesel regulations in 2010.

Experiments to determine the densities of CO₂-CH₄ mixtures at temperatures of 30 to 40°C and pressures of 10–200 bar were completed in February 2004. The new data are being used to develop mathematical expressions for application in numerical modeling of the processes and parameters that affect capture and retention of CO₂ in subterranean coal layers.

Through a multiyear CRADA with USEC, Inc., ORNL is assisting USEC in the development of an economically attractive gas centrifuge. The first tool-made sample rotor was completed under ORNL direction and sent to the test facilities at the East Tennessee Technology Park (ETTP), where the first low-speed balance test run was completed in January 2004. ORNL also completed installation of the balance stand instrumentation and control system at ETTP and began training USEC personnel in the operation of the equipment.

An interim report on cross-cutting candidate materials for high-temperature and radiation service in the Next Generation Nuclear Plant (NGNP) was issued in August 2004.

High-quality sintered UO_2 kernels with diameters of $350 \pm 10 \mu\text{m}$ were produced for use in tri-isotopic (TRISO) coating development studies, supporting the Depleted UO_2 Kernels Production Task of the Advanced Gas-Cooled Reactor Program.

ORNL also continued the development and testing of advanced aqueous separations processes applicable to the treatment of spent fuel from current and advanced light water reactors and the evaluation of separations processes for Generation IV Reactors. This work spanned six areas:

- Americium-curium recovery: Tests of the hydroxide precipitation/selective redissolution process were completed in August 2004.
- Conversion of plutonium-neptunium product to oxide via the modified direct denitration (MDD) process: Installation of the MDD glove box was completed, and final approval for operation with radioactive materials has been obtained. Final checkout of the equipment after closure of the glove box is in progress, and plans are being made for the transfer of the plutonium/neptunium feed solution from the hot cells to the glove box laboratory.
- Advanced head-end disassembly and Voloxidation: Differential thermal analysis (DTA)/thermogravimetric analysis (TGA) experiments with CsI, Cs_2MoO_4 , Se, and Te were completed. Experiments using cold surrogates of fission products at temperatures from ambient to 1200°C continue.
- Plutonium disposition: Zircalloy-clad plutonium-mixed oxide (MOX) fuel is being irradiated. Fuel and cladding from a pressurized water reactor (PWR) fuel pin irradiated to a burn up of 25,000 megawatt-days per metric ton of initial heavy metal (MW-d/MTIHM) were subjected to postirradiation analysis. Three cladding samples were completely dissolved and analyzed for actinides and fission products. The cladding sample with the largest amount of uranium and actinides had 3.54×10^{-4} g of U + TRU per gram of cladding, which translates to only 0.08% of the initial fuel left in the cladding.
- Direct chlorination of Zircalloy: A proof-of-principle test was carried out on a small sample of unirradiated PWR Zircalloy cladding crimped at both ends. The results indicate that chemical decladding using chlorine gas is feasible.
- Generation IV fuel treatment: Leaching experiments were conducted using UCO (~15% UC_2 in UO_2) with and without added carbon to simulate crushed TRISO-coated fuels. Leachates from the tests were filtered and further analyzed. Shaking the filtered solution did not produce persistent foam, qualitatively indicating that little organic acid was formed during the acid dissolution. Data from PUREX extraction tests on filtered leachates will be used to obtain distribution coefficients for comparison to calculated values. Filtered leachates were also analyzed using Fourier transform infrared (FTIR) techniques to identify the presence of carboxylic acids in the aqueous solution. While it appears that interference is caused by the aqueous matrix, carboxylic groups were detected. Additional experiments and further analysis of the data are planned.

ORNL completed optimized shield designs for candidate reactors of the Jupiter Icy Moons Orbiter (JIMO) Project. Peer reviewers, JIMO project management at the Jet Propulsion Laboratory, and DOE program managers indicated their satisfaction with the results.

ORNL also provided extensive support to Isotek, which holds the contract for performing Phase I, Planning and Design, of the ^{233}U Disposition, Medical Isotope Production, and Building 3019 Complex Shutdown Project.

National Nuclear Security Administration: Office of Defense Nuclear Nonproliferation

ORNL supports the nonproliferation programs of the National Nuclear Security Administration (NNSA) through work for the Material Protection, Control, and Accounting (MPC&A) program (NA-25); the Office of International Safeguards (NA-243); the Highly Enriched Uranium (HEU) Transparency Implementation Program (NA-232); and the Office of Nonproliferation Research and Engineering (NA-22).

- For the Nuclear Weapons Complex Division of NA-25, ORNL is supporting the implementation of safeguards and security systems at seven Russian sites that hold significant quantities of special nuclear materials (SNM), such as plutonium and HEU. Contract negotiations regarding the construction of a new plutonium storage facility at the Krasnoyarsk-26 site were completed, representing a major step forward in securing this weapons-usable material.
- For NA-243, ORNL assisted in preparations for implementing the U.S.-IAEA Additional Protocol by (1) constructing and releasing an Additional Protocol Reporting System (APRS) for beta testing and (2) conducting an inspection field trial at the HFIR/Radiochemical Engineering Development Center (REDC) complex.
- For NA-232, ORNL integrated the activities among several DOE laboratories in preparation for the installation of a Blend Down Monitoring System (BDMS) at the Siberian Chemical Enterprise in Seversk, Russia. The BDMS continuously monitors the flow and enrichment of HEU (as UF_6 gas), a blend stock, and low-enriched uranium as down blending occurs. All milestones were completed on schedule, and the Laboratory Director received a letter from the DOE program manager commending ORNL staff for their contributions to this project.
- For NA-22, ORNL is engaged in a multiyear project to develop a prototype miniature mass spectrometer that will markedly improve the ability to detect chemical species with high sensitivity and selectivity in the field. ORNL has assembled a battery-powered prototype instrument that displays mass spectra for the analysis of gas-phase effluents on a personal digital assistant (PDA) platform for ease of use in the field. In a demonstration on September 23, 2004, the prototype miniature mass spectrometer detected the presence of xenon in a helium buffer gas with reproducible spectra on the PDA.

Strategic Objective 2: Operations and ES&H

Our self-evaluation of ORNL's FY 2004 performance in operations and ES&H yields an overall rating of "Excellent." We believe that we continued to improve the overall operation of the Laboratory, and our performance against the PEP measures and indicators established for this critical outcome substantiates this belief. In FY 2004, we found that controls are generally in place and operating effectively to ensure that management's objectives are achieved. Opportunities to enhance these controls were identified and management has implemented suggestions for improvement, or action plans for implementation have been established.

- **Facilities modernization:**

- Notable progress was made in implementing ORNL's \$300 million modernization plan, which combines DOE, state, and private-sector funding. The Russell Laboratory for Comparative and

Functional Genomics became fully operational, and all Life Sciences Division staff previously located at Y-12 National Security Complex moved to the main Laboratory campus.

- The Advanced Microscopy Laboratory and the Multiprogram High Bay Facility, both GPP projects, and the state-funded facility housing the Joint Institute for Computational Sciences and the Oak Ridge Center for Advanced Studies were completed.
 - New parking lots were placed in operation, and landscaping of the new East Campus common area and entrance began late in the year.
 - The Research Support Center, a line item project, reached substantial completion as scheduled.
 - A total of 108,126 square feet of facility space has been deactivated and/or demolished.
- **Operational discipline:**
 - Significant improvements were seen in ORNL’s overall safety performance, with a dramatic decrease in the severity of injuries to personnel.
 - Outstanding environmental compliance performance was sustained by both operating and research organizations, and ORNL obtained ISO 14001 registration of its Environmental Management System.
 - Assessments of the Laboratory’s systems for performance-based management yielded high scores, and process improvement demonstrated increased maturity.
 - ORNL’s user facilities demonstrated outstanding availability and predictability (with the exception of HFIR, where availability was impacted by legacy and aging equipment issues), and goals for the production, packaging and shipment of isotopes were exceeded.
 - ORNL’s Integrated Safety Management (ISM) systems continue to mature; a team from the Office of Environment, Safety and Health Evaluations in DOE’s Office of Independent Oversight and Performance Assurance assessed ORNL’s ISM implementation and noted with approval the “major sea change” in the Laboratory’s safety culture since 2001.
- **Maximizing research effectiveness:**
 - ORNL demonstrated responsible cost management by delivering outstanding performance in the core composite rate (CCR).
 - A Voluntary Separation Program reduced the number of indirect chargers.
 - Changes to employee benefit plans reduced the growth in medical costs from a projected 15% to ~9%.
 - A new contract with bargaining unit staff is expected to produce cost savings of \$400,000 over the five-year term of the contract.
 - A Laboratory-wide workforce development strategy was launched, and the second annual “Day of Science” drew about 200 students and 70 faculty members from selected Historically Black Colleges and Universities (HBCUs) and the UT-Battelle Core Universities to ORNL for an event aimed at increasing minority student participation in the Laboratory’s undergraduate research programs.
- **Legacy issues:**
 - Outstanding progress was made in disposing of legacy materials that occupy valuable space, pose safety hazards, and hinder ORNL’s revitalization. A number of buildings were cleaned, four obsolete facilities were demolished, and several trailers were identified for removal.
 - Preliminary proposals and justification of mission need documents were developed for upgrades to once-through cooling water, sanitary waste, gaseous waste, and LLLW systems. These upgrades will reduce ES&H risks, improve effluent quality, and reduce operating costs.

We fell short of our objectives in three areas captured in the PEP: availability of the HFIR, consolidation of nuclear facilities, and hiring and promotion of women and members of minority groups. We are taking action to address each of these areas.

We are also dealing aggressively with issues and incidents that, while not reflected directly in the PEP, indicate that our level of operational discipline is not yet adequate to ensure consistently outstanding results in laboratory operations and ES&H.

The most disturbing of these was an incident in March 2004 that involved inadequate planning for the removal of a horizontal hoist in Building 7930. The ~3000-pound hoist fell 12 feet into a confined space occupied by two persons. Although no one was injured, this near miss provided sobering evidence that our level of operational discipline is not yet where we want it to be. The Laboratory Director's response to this incident included the initiation of a series of "rolling safety stand-downs." By mid-October 2004, these meetings will have given all ORNL employees the opportunity to hear the Laboratory's senior managers discuss their personal involvement in, and commitment to, safety.

We took other actions to address specific challenges:

- We appointed a "critique pilot" to improve the timeliness and quality of critiques of occurrences and to ensure that line organizations understood how to conduct effective critiques; the result was an improvement in the quality and timeliness of the critiques and, more importantly, in the learning and corrective actions resulting from them. We followed up by training a cadre of highly skilled critique facilitators as a resource for line management.
- We implemented a Laboratory Space Manager Program to ensure that the hazards of activities and operations in laboratories and experimental spaces at ORNL are identified, and controlled, and that the space is maintained in a clean and orderly manner.

As our self-assessment results and our analyses of self-disclosed events reveal areas in which we can make improvements, we will continue to develop and implement specific plans for doing so. We believe that we are now seeing the beginning of a permanent change in culture. We will continue working to achieve outstanding results in operations and ES&H, with the goal of sustaining and improving ORNL's ability to deliver world-class science and technology.

Strategic Objective 3: Community Service

Our self-evaluation of ORNL's FY 2004 performance in community service yields a rating of "Outstanding."

UT-Battelle is committed to ensuring that ORNL is viewed by its neighbors as a highly valued partner in the region. In FY 2004, we delivered on this commitment through active participation in economic development, support of the community's civic and cultural activities, and continuing efforts to strengthen science and math education. We also supported a number of volunteer efforts by ORNL employees through Team UT-Battelle.

- **Economic Development:**

- In partnership with DOE, we secured approval to begin a program of privately funded technology transfer (PFTT), which enables UT-Battelle to invest in ORNL technologies. We have also submitted to DOE a proposal for a Use Permit, which would provide a means for UT-Battelle to contract directly with private customers.
- Four ORNL innovations were recognized with awards of excellence in technology transfer from the Federal Laboratory Consortium for Technology Transfer: the "Lab-on-a-Chip" technology, thin-film lithium batteries, microcantilever-based



Wireless technologies will improve tracking and locating capabilities for maritime shipping companies.

sensors, and robust wireless technologies for extreme-environment communications. No laboratory can win more than 4 of the 28 awards presented, and ORNL was the only institution to win four awards.

- **Community Involvement:**

- In October 2003, ORNL and the University of Tennessee co-hosted the Council for the Advancement of Science Writing's 2003 New Horizons Briefing, which brought almost 200 science writers and other journalists to East Tennessee to learn about new developments in science, medicine and technology.
- UT-Battelle's support for the revitalization of Oak Ridge High School, including the promise of a \$2 million gift to the Oak Ridge Public School Education Foundation, was a critical factor in community approval of a sales tax referendum that will provide funds for developing a 21st century educational facility.

- **Science and Math Education:**

- UT-Battelle continued its program of purchasing science laboratories for middle schools and high schools throughout the state of Tennessee, providing \$10,000 gifts to five schools.
- UT-Battelle became a prime sponsor of the University of Tennessee Math Olympiad, sponsoring 10 students from Antioch High School to the Olympiad and awarding them internships.
- UT-Battelle awarded four \$5,000 University of Tennessee scholarships in math and science to students from the Bearden, Farragut, Lenoir City, and Oak Ridge high schools.
- UT-Battelle donated \$150,000 to fund a University of Tennessee science education workshop for 40 middle school teachers from East Tennessee counties. The goal of the workshop is to increase teachers' knowledge and understanding of science and enhance their ability to teach science.

Information Presented in this Report

Part I of this report presents UT-Battelle's assessment of its performance in meeting the commitments documented in the PEP for FY 2004. Parts II through V contain information from other areas that we believe are indicators of UT-Battelle's overall performance:

- a description of the focus and impact of our internal investments in science and technology,
- a summary of the direction and results of our internal investments in management systems and operations,
- a report on our operational experience, covering both self-disclosed events (issues that were "surprises") and issues that we identified and addressed, and
- a description of depth, breadth, and maturity of our overall planning and self-assessment programs and overall strengths and weaknesses.

Part VI summarizes our key strengths and areas for improvement, drawing on the results of our self-assessments at all organizational levels and on other information presented in this report.

Closing Comments

In many respects, ORNL had a banner year in FY 2004. We delivered notable achievements in science and technology, advanced toward our objectives in operations and ES&H, and sustained our stellar record in community service. While our sense of accomplishment is tempered by our knowledge of what remains to be done, we are confident that we are on the right track to continue our progress toward our goal of becoming the world's best research laboratory.

In summary, on the basis of the evidence presented in this report, we believe that the Laboratory's overall performance for FY 2004 is "Outstanding."

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ACRONYMS AND ABBREVIATIONS

AAAHc	Accreditation Association for Ambulatory Health Care
ACC	Automotive Composites Consortium
ACEM	aberration-corrected electron microscope
ACH	Automated Clearing House
AE	Architect Engineer
AGR	Advanced Gas Reactor
AIDS	Acquired Immune Deficiency Syndrome
ALARA	as low as reasonably achievable
AMD	age-related macular degeneration
AML	Advanced Microscopy Laboratory
AMS	Acquisition Management System
ANL	Argonne National Laboratory
ANSI	American National Standards Institute
AP	Additional Protocol
APRS	Additional Protocol Reporting System
ARM	Atmospheric Radiation Measurement
ATLC	Atomic Trades and Labor Council
ATR	Advanced Test Reactor
ATS	Assessment Tracking System
AVID	Accelerated Vendor Inventory and Delivery
BA	Budget Authorization
BDMS	Blend Down Monitoring System
BER	Biological and Environmental Research
BES	Basic Energy Sciences
BIO	Basis for Interim Operation
BNL	Brookhaven National Laboratory
BTA	Beta Test Agreement
CAA	Clean Air Act
CCL	coupled-cavity linac
CCO	Communications and Community Outreach
CCR	Core Composite Rate
CCS	Center for Computational Sciences
CCSM3	Community Climate System Model
CCSP	Climate Change Science Program
CD	Critical Decision
CDC	Center for Disease Control
CDIAC	Carbon Dioxide Information Analysis Center
CFRFS	Computational Facility for Reacting Flow Science
CEG	Center for Entrepreneurial Growth
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHP	combined heating and power
CLIA	Clinical Laboratory Improvement Amendments
CLO	Central Laboratory and Office
CM	Construction Manager or Commercialization Manager
CMC	Chemical Management Center

CNMS	Center for Nanophase Materials Sciences
CPPR	Comprehensive Publications and Presentations Registry
CRADA	Cooperative R&D Agreement
CSMB	Center for Structural Molecular Biology
D&D	decontamination and decommissioning
DART	days away, restricted, or transferred
DCA	Dynamical Cluster Approximation
DHS	Department of Homeland Security
DNA	deoxyribonucleic acid
DNFSB	Defense Nuclear Facilities Safety Board
DOE	Department of Energy
DOE-EE	Department of Energy Office of Energy Efficiency and Renewable Energy
DOE-EM	Department of Energy Office of Environmental Management
DOE-FE	Department of Energy Office of Fossil Energy
DOE-HQ	Department of Energy Headquarters
DOE-NE	Department of Energy Office of Nuclear Energy, Science, and Technology
DOE-OA	Department of Energy Office of Independent Oversight and Performance Assurance
DOE-OE	Department of Energy Office of Enforcement
DOE-OEA	Department of Energy Office of Energy Assurance
DOE-OIG	Department of Energy Office of the Inspector General
DOE-ORO	Department of Energy Oak Ridge Operations Office
DOE-SC	Department of Energy Office of Science
DOELAP	Department of Energy Laboratory Accreditation Program
DTL	drift tube linac
EAC	Estimate at Completion
ECRs	Environmental Compliance Representatives
EEO	Equal Employment Opportunity
EIA	Energy Information Administration
eIDR	Electronic Invention Disclosure Reporting
EM	Environmental Management
EMS	Environmental Management Services or Environmental Management System
EMSP	Environmental Management Science Program
EPA	Environmental Protection Agency
EP&WSD	Environmental Protection and Waste Services Division
EREL	Energy Reliability and Efficiency Laboratory
ERSD	Environmental Remediation Sciences Division
ESG	Earth System Grid
ETC	Estimate to Complete
ETF	Extensible Terascale Facility
ES&H	Environment, Safety, and Health
ESH&Q	Environment, Safety, Health, and Quality
ETTP	East Tennessee Technology Park
EVEREST	Exploratory Visualization Environment for Research in Science and Technology
EVMS	Earned Value Management System
FACE	Free Air CO ₂ Enrichment
FDD	Facilities Development Division
FDDMS	Facilities Development Division Management System
FEM	fissionable equivalent mass
FFCA	Federal Facility Compliance Act

FIMS	Facility Information Management System
FITR	Fourier transform infrared
FLC	Federal Laboratory Consortium
FPE	Fire Protection Engineering
FRC	Field Research Center
FRP	Facilities Revitalization Program
FUA	Facility Use Agreement
FWP	Field Work Proposal
FY	fiscal year
GAN	Gostatomnadzor
GAO	General Accounting Office
GATT	General Agreement on Tariffs and Trade
GM	General Motors
GPP	General Plant Project
GSF	gross square footage
GTL	Genomes to Life
HBCUs	Historically Black Colleges and Universities
HEU	highly enriched uranium
HFIR	High Flux Isotope Reactor
HIV	human immunodeficiency virus
HR	Human Resources
HRIBF	Holifield Radioactive Ion Beam Facility
HSI	Health and Safety Initiative
HTML	High Temperature Materials Laboratory
HTSC	high-temperature cuprate superconductor
HVAC	heating, ventilating, and air-conditioning
HVCM	high-voltage converter modulator
IA	Internal Audit
IAEA	International Atomic Energy Agency
IBM	International Business Machines
ICP/MS	inductively coupled plasma/mass spectrometry
IEA	International Energy Agency
IGPP	Institutional General Plant Project
INEEL	Idaho National Engineering and Environmental Laboratory
IO	Independent Oversight
IP	Intellectual Property
IPCC	International Panel on Climate Change
ISIS	Integrated Supplier Information System
ISM	Integrated Safety Management
ISO	International Standards Organization
IT	Information Technology
IT&M	inspection, testing, & maintenance
ITER	International Thermonuclear Experimental Reactor
IWP	Integrated Work Plan
JAERI	Japan Atomic Energy Research Institute
JGI	Joint Genome Institute
JICS	Joint Institute for Computational Sciences

JIMO	Jupiter Icy Moon Orbiter
JINS	Joint Institute for Neutron Sciences
kW	kilowatt
LANL	Los Alamos National Laboratory
LCFG	Laboratory for Comparative and Functional Genomics
LDRD	Laboratory Directed Research and Development
LEED	Leadership in Energy and Environmental Design
LEU	low enriched uranium
LIMS	Laboratory Information Management System
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
LLLW	liquid low-level waste
LMDI	Legacy Materials Disposition Initiative
LSM	Laboratory Space Manager
LTA	less than adequate
LTC	lost time away case
LWS	Laboratory Waste Services
MANDI	Macromolecular Neutron Diffractometer
MBA	material balance area
MCI	Mobile Clinics International
MDD	modified direct denitration
MJR	maintenance job request
MII	Maintenance Investment Index
MOU	memorandum of understanding
MOX	mixed oxide
MPC&A	Material Protection, Control, and Accounting
MSRE	Molten Salt Reactor Experiment
MTIHM	metric ton of initial heavy metal
MW	megawatt
MW-d	megawatt-days
MWP	Maintenance Work Plan
NABIR	Natural and Accelerated Bioremediation Research
NACP	North American Carbon Program
NCAR	National Center for Atmospheric Research
NCSA	nuclear criticality safety analysis
NDA	Nondisclosure Agreement
NETL	National Energy Technology Laboratory
NGNP	Next Generation Nuclear Plant
NHGRI	National Human Genome Research Institute
NHI	National Hydrogen Initiative
NIBIB	National Institute for Biomedical Imaging and Bioengineering
NIH	National Institute of Health
NIST	National Institute of Standards and Technology
NLCF	National Leadership Computing Facility
NLR	National LambdaRail
NMC&A	Nuclear Materials Control and Accountability
NNFD	Nonreactor Nuclear Facilities Division
NNSA	National Nuclear Security Agency

NPDES	National Pollution Discharge Elimination System
NRC	Nuclear Regulatory Commission
NSF	National Science Foundation or National Sanitation Foundation
NSTD	Nuclear Science and Technology Division
NSVI	Nuclear Safety Violation Index
NTRC	National Transportation Research Center
NTS	Nevada Test Site or Non-Compliance Tracking System
O&AS	Oversight and Assessment Services
O&M	Officials and Managers
OAP	Operational Awareness Program
OECM	Office of Enforcement and Compliance Monitoring
OGC	Office of General Counsel
OIP	Operations Improvement Program
OM&S	operations, maintenance, and services
ORCAS	Oak Ridge Center for Advanced Studies
ORNL	Oak Ridge National Laboratory
ORO	Oak Ridge Operations Office
ORPS	Occurrence Reporting and Processing System
OSHA	Occupational Safety and Health Administration
P4	Programmable Powdered Preform Process
P-AAA	Price-Anderson Amendments Act
PBM	performance-based management
PBMS	Performance-Based Management System
PCAT	Powerline Conductor Accelerated Testing
PCB	polychlorinated biphenyl
PD	program development
PDA	personal digital assistant
PEP	Performance Evaluation Plan
PER	Program for Ecosystem Research
PERT	Procurement Evaluation and Re-engineering Team
PFTT	privately-funded technology transfer
PNNL	Pacific Northwest National Laboratory
POP	Pacific Ocean Program
PPPL	Princeton Plasma Physics Laboratory
PWCCB	PartnerWorks Change Control Board
PWR	pressurized water reactor
QPS	Quasi-Poloidal Stellarator
QSD	Quality Services Division
R2A2s	roles, responsibilities, authorities, and accountabilities
R&D	research and development
RCRA	Resource Conservation Recovery Act
RCV	replacement cost value
RE	rare earth
REDC	Radiochemical Engineering Development Center
RERs	Radiological Event Reports
RFP	Request for Proposal
RIBs	radioactive ion beams

RH	remote-handled
RII	recordable injury and illness
ROB	Research Office Building
ROI	Radiological Operations Index
ROM	rough order-of-magnitude
RP	retinitis pigmentosa
RRD	Research Reactors Division
RSC	Research Support Center
RSS	research safety summary
S&T	science and technology
SB	Safety Basis
SBMS	Standards-Based Management System
SChE	Siberian Chemical Enterprise
SciDAC	Scientific Discovery through Advanced Computing
SETENS	Southeastern TeraGrid Extensions for Neutron Sciences
SGI	Silicon Graphics, Inc.
SIOU	Surface Impoundment Operable Units
SNS	Spallation Neutron Source
SPF	specific-pathogen-free
STEM	scanning transmission electron microscopy
SWE	Society of Women Engineers
T&D	transmission and distribution
TBD	to be determined
TDEC	Tennessee Department of Environment and Conservation
TEM	transmission electron microscopy
TEMA	Tennessee Emergency Management Administration
TGA	thermogravimetric analysis
TRC	total recordable case
TRISO	tri-isotopic
TRU	Transuranic
TSCA	Toxic Substances Control Act
TSI	TeraScale Supernova Initiative
TSR	Technical Safety Requirement
TTED	Technology Transfer and Economic Development
TVA	Tennessee Valley Authority
UAV	unmanned aerial vehicle
US	United States
USEC	United States Enrichment Corporation
USPTO	United States Patents and Trademarks Office
USQ	Unreviewed Safety Question
UT	University of Tennessee

WAG	Waste Area Grouping
WAND	Wide-Angle Neutron Diffractometer
WFO	Work for Others
WMD	weapons of mass destruction
WPCC	Work/Project Planning and Control
WSRs	Waste Services Representatives
WSS	Work Smart Standards

INTRODUCTION

UT-Battelle's management of the Oak Ridge National Laboratory (ORNL) is guided by a fundamental commitment to simultaneous excellence in science and technology; laboratory operations and environment, safety, and health (ES&H); and community service. The UT-Battelle Leadership Team maintains a Laboratory Agenda to provide a structured framework for the strategic objectives, critical outcomes, major initiatives, and near-term actions through which it plans to deliver on this commitment.

Under the terms of its performance-based contract with the U.S. Department of Energy (DOE), UT-Battelle also prepares an annual Performance Evaluation Plan (PEP) that documents a set of critical outcomes and performance measures that are used to determine the fee paid to UT-Battelle for its management and operation of ORNL. These critical outcomes and performance measures, which address the full scope of ORNL programmatic and operational activities, reflect the consensus of UT-Battelle and our DOE customers on the essential aspects of UT-Battelle's performance in its management and operation of ORNL. (In general, the PEP and the Laboratory Agenda are closely aligned. The Laboratory Agenda, however, reflects UT-Battelle plans and goals for ORNL that may not be captured explicitly in the PEP.)

To support the proactive planning, effective allocation of resources, and assessments of performance that are needed to successfully execute the Laboratory Agenda and meet our commitments to DOE, UT-Battelle uses a performance-based management system (PBMS). The PBMS provides a formal process for developing business plans and performance assessment plans, conducting assessments of performance, analyzing the results, and making improvements as needed. It is used by both line managers at all levels (directorate, division, group, program, and project) and management system owners (persons with responsibility for ORNL's high-level operating and business processes). Self-assessment plans are used to refine and tailor the performance-based management process at each level. The highest-tier product resulting from the full utilization of the PBMS is this Self-Evaluation Report.

This report also meets the requirement, established in the PEP, for UT-Battelle to provide an evaluation report to the ORNL Site Office at the end of the year, with the following content:

- an overall summary of performance for FY 2004,
- performance ratings for each performance goal and for the Laboratory overall,
- a summary of key strengths and opportunities for improvement identified as part of the division and directorate self-assessment activities,
- any significant issues that were identified by external audits, reviews, etc., and
- any issues or topics that the contractor deems important to discuss.

Part I of this report presents UT-Battelle's assessment of its performance in meeting the commitments documented in the PEP for fiscal year (FY) 2004. Parts II through V contain information from other areas that we believe are indicators of UT-Battelle's overall performance.

- Part II presents the focus, impact, and results of our internal investments in S&T.
- Part III summarizes the direction and results of our internal investments in infrastructure, operations, and Laboratory reserve-funded initiatives.
- Part IV is a report on both self-disclosed events (issues that were "surprises") and issues that we identified and addressed.
- Part V describes the depth, breadth, and maturity of our overall planning and self-assessment programs and reviews the strengths and weaknesses of our management systems and their maturity.

Part VI presents the required summary of key strengths and areas for improvement, which draws on the results of our self-assessments at all organizational levels and on other information presented in this report.

PART I: PERFORMANCE EVALUATION PLAN RESULTS

The Performance Evaluation Plan (PEP), prepared to describe the basis for the evaluation of UT-Battelle's performance in the management and operation of the Oak Ridge National Laboratory (ORNL) during fiscal year (FY) 2004, contains the set of critical outcomes and performance measures presented in Table I.1. In this part of the Self-Evaluation Report, we present our assessment of UT-Battelle's success in meeting the expectations of our Department of Energy (DOE) customers for each performance measure.

Table I.1. FY 2004 Critical Outcomes and Performance Measures

Critical Outcome	Performance Measures
1. Excellence in Science and Technology	1.1 Quality of Research 1.2 Relevance to DOE Mission and National Needs 1.3 Success in Constructing and Operating Research Facilities 1.4 Effectiveness and Efficiency of Research Program Management (NOTE: Measures 1.1–1.4 form the basis for a composite evaluation of continued scientific excellence) 1.5 Deliver SNS on Schedule, on Budget, and with Full Scope 1.6 Progress Towards New Science Capability
2. Excellence in Operations and Environment, Safety, and Health (ES&H)	2.1 Facilities Modernization 2.2 Operational Discipline 2.3 Maximize Research Effectiveness 2.4 Legacy Issues
3. Excellence in Community Service	3.1 Be Recognized Within the Region as a Good Corporate Citizen 3.2 Encourage the Growth of Businesses Based on ORNL Technology and/or Resources to Enhance the Economy

1. EXCELLENCE IN SCIENCE AND TECHNOLOGY

To meet the critical outcome of excellence in science and technology (S&T), UT-Battelle has committed to deliver scientific advances and technological innovations that support Department of Energy (DOE) missions, apply our expertise and capabilities to the needs of other customers, and sustain and enhance the distinctive capabilities of the Oak Ridge National Laboratory (ORNL). In FY 2004, ORNL delivered outstanding S&T performance to a diverse customer base.

1.1–1.4 CONTINUED SCIENTIFIC EXCELLENCE

Preliminary Score: 3.51

Rating: Outstanding

Four of the performance measures established for the critical outcome in S&T are designed to measure ORNL's effectiveness as a research and development (R&D) performer for DOE program sponsors and for other customers. The principal tool for measuring ORNL's performance in the areas covered by these measures is a survey, administered by the DOE ORNL Site Office, that collects direct feedback from these program sponsors on the quality of ORNL's research, the relevance of the research to DOE mission and national needs, ORNL's success in constructing and operating research facilities, and the effectiveness and efficiency of ORNL's research program management. While survey results are not yet complete, preliminary indications are that the results of these surveys, which are combined to yield a composite rating of ORNL's continued scientific excellence, will demonstrate that the Laboratory continued to meet DOE's expectations. In addition, ORNL surveys its Work for Others (WFO)

customers, and these surveys likewise indicate a high level of satisfaction with ORNL's S&T performance.

We also assess ORNL's S&T performance against a set of S&T Stewardship Priorities, documented in Appendix B of the FY 2004 PEP. Overall, our delivery of results for our principal program sponsors has been outstanding, as described in detail below.

Office of Science: Office of Basic Energy Sciences

1. Complete a HFIR Aging and Life Extension Study.

Results: A document providing both a summary of the management programs used to identify and manage aging equipment at the HFIR and a plan that integrates the implementation of these activities with the system engineering program was issued September 24, 2004.

The aging equipment analysis provides input to the HFIR integrated work plan (IWP). The IWP contains a comprehensive listing of all activities needed to ensure that HFIR systems, structures, and components are maintained reliably.

Rating: Outstanding

2. Complete installation of the beam room HB-4 tunnel and initiate installation of the cold guide system.

Results: The installation of the cold guide system was initiated in late August 2004. The HB-4 tunnel project was delayed several months by the limited availability of the needed technical resources at HFIR. It was further delayed in June by the DOE-imposed hoisting and rigging moratorium for heavy lifts at DOE-NE facilities. Concrete pours have now begun and the current schedule for completion of the HB-4 tunnel installation is January 2005. This delay has no impact on the cold source schedule.

Rating: Excellent

3. Develop and implement an integrated schedule for HFIR operations, maintenance, upgrades, experiments, and support activities.

Results: The HFIR FY 2004 IWP was issued on January 7, 2004. The first revision of the IWP for FY 2005–FY 2007 has been issued.

Rating: Outstanding

4. Hire a director for the Center for Neutron Scattering.

Results: The Executive Director for HFIR and the Center for Neutron Scattering, David Price, was hired and reported to work on May 3, 2004.

Rating: Outstanding

5. Maintain cost and schedule for CNMS construction.

Results: At the end of August, the Center for Nanophase Materials Sciences (CNMS) construction project was within budget and on schedule. The project was 38.4% completed with a cost performance index of 1.02 and a schedule performance index of 1.00. The actual cost of work to date

was \$21,800,000 compared to a budgeted cost of work scheduled of \$22,117,000. The project is on course to meet the CD-4a milestone in April 2005 and the CD-4b milestone in September 2006. Major long-lead-time technical equipment items have been ordered, including the electron beam lithography system, the instrument with the highest cost and longest lead-time. The bids for the focused ion beam system, another of the major procurements, have been assessed and the commitment for this item is in place. In the construction of the building, installation of the metal siding is well under way, with completion expected in December 2004. The installation of the ductwork in the clean room began in August. Also under way is installation of drywall in the laboratory area in the four-story portion of the building.

Rating: Outstanding

6. Implement the CNMS user program.

Results: The CNMS user program was successfully implemented with a national call for proposals and the establishment of an independent Proposal Review Committee. At year's end, 33 of 42 approved projects were active. The CNMS announced the second Call for Proposals for user projects from November 2004 through October 2005. New user proposals were due September 30 and will be reviewed by the Proposal Review Committee during October. The CNMS is also implementing a process for renewal of active user projects based on receipt of a renewal request from the project and demonstration of satisfactory progress in the prior year. Most of the currently active projects are expected to be renewed.

Rating: Outstanding



CNMS building exterior and
CNMS ductwork installation

Office of Science: Office of Biological and Environmental Research

1. Support Genomes to Life (GTL) with an integrated ORNL resource in systems biology, including microbial genomics, genome-scale proteomics and protein complex analysis (including mass spectrometry, advanced sample preparation and handling, cellular imaging, microarrays, and other relevant analytical technologies), and computational biology and bioinformatics.
 - Meet all ORNL-specific milestones for the ongoing funded GTL project on time and within budget.
 - Position ORNL for comprehensive response in support of growth and future directions in GTL (research and facilities).
 - Coordinate activities needed to establish a deuteration capability for the Center for Structural Molecular Biology.
 - Continue to provide strong support to BER in development of GTL facility plans and documentation.

Results: The ongoing Genomics:GTL project, the Center for Molecular and Cellular Systems, has focused on the identification and characterization of protein complexes to elucidate cellular function in two microbial systems, *Shewanella oneidensis* (*S. oneidensis*) and *Rhodopseudomonas palustris* (*R. palustris*). The goal is to obtain a knowledge base that can provide insight into the relationship between the complement of protein complexes in these microbes and their biological function. State-of-the-art techniques for the identification and characterization of protein complexes are

employed, building toward meeting the high-throughput requirements of the Genomics:GTL program and linking the data obtained to biological function.

Significant management and research activities include the operation of the production “pipeline,” the implementation of the Laboratory Information Management System (LIMS), and the identification of electron microscopy as a potential imaging tool.

The pipeline ran for 22 weeks, processing four one-liter cultures per week. Mass spec data analysis of the pipeline was implemented. The growth of bacterial cells is recognized to be the primary rate-limiting step, but efforts are under way to address this obstacle.

LIMS now provides a central data repository for project samples; enforces project standards via required data fields and controlled vocabulary; integrates project data; supports project management and publications; and provides data security for the project. LIMS is up to date with production data for 21 production pipeline batches and 56 different genes.

The potential use of electron microscopy is significant because it would provide quantitative three-dimensional imaging and spatially resolved biochemical characterization of protein complexes. However, specimen sampling and preparation are still in the early stages, and attention and some new technology are needed to provide the high throughput, zero damage, and zero contamination parameters that would be part of a factory operation. Research into this exciting possibility is expected to be pursued in FY 2005.

A monthly reporting format has been implemented, and reports are posted on the project Web site. Task groups meet regularly, and conference calls between ORNL and Pacific Northwest National Laboratory (PNNL) occur routinely. Three manuscripts based on the project were submitted; one of these is in press.

To support GTL growth and future directions, several ORNL staff participated in a March 2004 road mapping workshop on GTL’s impact on DOE missions and in a June 2004 GTL Technology “Deep Dive” workshop. ORNL staff co-chaired breakout sessions, provided support to the workshops, and organized reports of the output.

To support program development, ORNL created the position of Systems Biology Scientific Director and began a search for an outstanding candidate.

Progress continues toward establishing deuteration capabilities in the Center for Structural Molecular Biology (CSMB), with outreach to the U.S. science community to highlight the advantages and capabilities of deuterium labeling for neutron scattering applications in biology. Plans for CSMB, including the development of deuteration capabilities and of the Macromolecular Neutron Diffractometer (MANDI) at SNS, were presented to BER program managers. To expand ORNL capabilities in neutron scattering, two candidates were identified for interviews. One interview was conducted and an offer extended. Commissioning of a small angle X-ray scattering instrument is also under way.

ORNL staff provided strong support to BER in development of GTL facility plans and documentation, participating in GTL planning and road mapping throughout the year. Planning documents and community outreach processes for GTL, facilitated by ORNL, were viewed as

exceeding program expectations. ORNL is also organizing follow-on workshops to develop an infrastructure roadmap for data management, analysis and simulation tools.

Rating: Outstanding

2. Extend genome-enabled biology to advance the science of carbon sequestration, renewable energy systems, bioremediation, and ecosystem research in support of DOE missions.
 - Collaborate with JGI on finalizing the *Populus* sequencing, assembly, and initial annotation; continue to co-lead the International Populus Genome Consortium; and complete the scientific program plan for the Consortium.
 - Continue leadership in microarray science and technology for DOE by completing deliverables for the Shewanella Federation, NABIR, and BI-OMP projects.
 - Provide *Shewanella* whole-genome microarrays to Federation investigators and other DOE-funded investigators.
 - Generate deletion mutants important to energy metabolism and regulation.
 - Generate large-scale random mutants for genes involved in metal metabolism reduction revealed by microarrays.
 - Complete installation of the clean room for the microarray facility.
 - Participate in efforts to generate data standards, data exchange, and data comparisons and actively seek out, test, and implement state-of-the-art technology improvements in microarray technology.

Results: The final draft annotation of the *Populus* genome (the first tree genome to be sequenced and annotated) is being completed with ongoing modifications in the assembly based on the genetic map. The *Populus* genome will be a model plant genome to understand plant-based processes that influence carbon sequestration, phytoremediation, and bio-based products such as ethanol. The public release of the *Populus* genome took place in September 2004 and included an international press release, coordinated by International Populus Genome Consortium members. This genome will be the basis of several proposals to DOE and the National Science Foundation (NSF). The NSF/DOE project on *Populus* is being completed and Web-based access to the genomic resources has begun.

Updates to the International Populus Genome Consortium Web site continue, to reflect progress in sequencing the genome, and ORNL is working with New Phytology to organize a workshop on the molecular basis for adaptation (to take place in October 2004). Final revisions to the *Populus* Genome Science Plan were completed to coincide with the public release of the annotated genome

ORNL continued to provide *Shewanella* whole-genome arrays to Shewanella Federation members. Two papers on using microarrays to study gene expression profile are in press. More than 40 deletion mutants important to energy metabolism and regulation have been generated. Some of them have been characterized extensively using chemostats and batch culturing methods. About 30 insertional mutants for genes involved in metal metabolism have been generated. The clean room has been installed and the microarray is operational. Clean room operating procedures are being finalized. ORNL has developed gDNA as a universal reference standard, and this will be implemented in future microarray studies.

A 624-page book, *Microbial Functional Genomics*, by Jizhong Zhou and Dorothea K. Thompson of ORNL, Ying Xu, and James M. Tiedje (all supported by DOE's Office of Science) was published by John Wiley and Sons in 2004. As the first comprehensive treatment of this subject, the book provides

a timely synthesis and summary of the principles, approaches and applications of microbial functional genomics.

Rating: Outstanding

3. Redirect research focus of mammalian genetics research program to align it with the DOE need to annotate human chromosomes 5, 16, 19.
 - Submit proposal to BER for peer review by April 15, 2004.
 - Increase number of publications by 50% over FY 2003.

Results: Three proposals were submitted to DOE on April 5, 2004, to redirect the programmatic focus toward the annotation of human chromosomes 5, 16, and 19. A fourth proposal requested funding for operation of the Laboratory for Comparative and Functional Genomics.

The number of publications increased from 11 in FY 2003 to 20 in FY 2004 an increase of slightly more than an 80%.

Rating: Outstanding

4. Organize and facilitate a joint workshop between DOE and NIBIB to develop a new signature research objective at the intersection of medicine, biology, and nanotechnology.

Results: The National Institute for Biomedical Imaging and Bioengineering (NIBIB)/DOE Workshop on Biomedical Imaging: Optical and X-ray Technologies was held in February 2004, bringing together approximately 100 researchers from the National Institutes of Health (NIH) and DOE as well as program staff from NIH and DOE. The meeting defined the technology needs of NIH researchers that could be addressed by national laboratory capabilities. The presentations and poster sessions were of very high quality, and the discussion resulted in some specific recommendations and suggestions for future opportunities and actions to improve the working relationship between NIH and the national laboratories' scientists. The meeting will serve as a model for future meetings that bridge NIH and DOE interests, including a joint DOE/NIH Workshop on Nanobiomedicine to be held in spring 2005.

Rating: Outstanding

5. Provide computational annotation to support DOE sequencing efforts.
 - Final annotation of *Rhodopseudomonas*, *Yersinia pseudotuberculosis* (LLNL), *Methanococcus maripaludis*, and *Rhodobacter sphaeroides*.
 - Pending availability, annotation of 11 draft genomes from set sequenced by JGI in 2003.
 - Annotation assistance to Michigan State University group (Tiedje et al.) for *Psychrobacter* and *Burkholderia*.

Results: The *Rhodopseudomonas* work was featured on the cover of *Nature Biotechnology*.

Final annotation of *Rhodopseudomonas*, *Yersinia pseudotuberculosis*, *Methanococcus maripaludis*, *Nostoc punctiforme*, and *Rhodobacter sphaeroides* was completed. *Rhodopseudomonas* was completed during the first quarter with periodic maintenance updates since; this work was featured on the cover of *Nature Biotechnology*. The *Yersinia pseudotuberculosis* genome was released, and a *Proceedings of the National Academy of Sciences* manuscript is in press. The *Methanococcus* genome was released, and a manuscript is in press at *J. Bacteriol.* For *Nostoc*, annotation of the closed

genome is proceeding in expert phase. The *Rhodobacter* chromosome II sequence polishing was completed and chromosome I is in progress.

ORNL has processed all bacterial and archaeal sequences for the DOE microbial program, as well as some eukaryotic microbes. We have processed 32 of the 2004 group and reprocessed 61 of the prior-year genomes, including 14 finished genomes that we are processing to publish (in addition to the eight already published or in press).

Annotation assistance to Michigan State University group (Tiedje et al.) for *Psychrobacter* and *Burkholderia* was rated as excellent. The expert phase of annotation was completed for *Psychrobacter*, and a manuscript is in preparation. *Burkholderia* was closed and is in expert phase.

Rating: Outstanding

6. Support the missions of the Climate Change Research Division through the use of our core scientific capabilities in ecosystem dynamics, carbon and water cycle, global climate change modeling, carbon sequestration, and global change data.
 - Program for Ecosystem Research (PER)
Prepare a draft synthesis manuscript by September 30, 2004, on the relative importance of multiple environmental change drivers (e.g., elevated CO₂, increasing temperature, water stress, and ozone exposure) on deciduous forest ecosystems of the Eastern United States.
 - Atmospheric Radiation Measurements (ARM) Program
 - Develop a new user graphics-based interface (Thumbnail browser) that will enable new pathways for users to identify ARM data that meets their needs. The brief, graphical view of the ARM data will enable a wider technical range of data users to identify interesting data. It will also enable experienced users to quickly find instances that cannot be searched for quantitatively. Development should progress to an initial version by the end of the fiscal year.
 - Develop routine reports of performance measures based on data completeness and timeliness of data delivery. These reports are based on statistics extracted from the ARM Archive holdings and demonstrate the success of ARM as a User Facility. Reports will be updated monthly and will also include summarization of Archive user activity.
 - Computational Climate Simulation
Provide a validated, vectorized version for the CRAY X1 of the Community Climate System Model (CCSM3) after its public release May 18, 2004, and support the IPCC simulations in conjunction with Warren Washington's group at NCAR, by providing computer resources to complete ensemble studies of the B1 Scenario using the CCSM3 (coupled T85 atm, one degree ocean, land and sea ice) and provide storage facilities for analysis of output (30TB) made available on the DOE SciDAC Earth System Grid.
 - Carbon Cycle and Sequestration
 - Submit journal publication (Global Biogeochemical Cycles) by June 30, 2004, that describes the results of simulations that quantify the influence of climate and CO₂ on terrestrial system ecophysiology
 - Deliver draft report to DOE by April 30, 2004, on "Quantifying Representation and Using Representation Weights to Interpolate Flux Tower Measurements across the United States."
 - Implement new flux measurements to study carbon exchange and water use in Ozark forests in Missouri: start taking flux measurements by May 2004; achieve an up-time of at least 70% for the three months, and at least 75% afterwards; no continuous flux data gaps longer than a week; and no overlapping flux and meteorological data gaps.

- Prepare plan by September 30, 2004, for logical transition of the ORNL FACE site and a draft concept for the next large-scale experiment to be conducted.
- Prepare concept paper for DOE review by June 30, 2004, on an approach for scaling terrestrial carbon sequestration strategies to regional scales.
- Carbon Dioxide Information and Analysis Center (CDIAC)
To satisfy the need for fossil-fuel CO₂ emission estimates with finer spatial and temporal resolution as highlighted by the North American Carbon Program (NACP) and Climate Change Science Program (CCSP), CDIAC will develop monthly and state-level fossil-fuel CO₂ emission time series for the United States. Available U.S. energy data permit emission estimates by month back to 1980, and emissions by state back to 1960. All time series will be fully documented and made available on the CDIAC Web site by September 30, 2004.

Results: PER performance was Excellent. The draft manuscript was prepared for the DOE sponsor as scheduled.

ARM performance was Outstanding. The thumbnail browser is nearing completion; a version with limited functionality has been made accessible to users, and some additional feedback has been acquired. Testing and user documentation were being completed during September 2004 and the application was to be put into production in October 2004.

Performance measures based on data completeness were developed for the flow of data into the ARM-Archive and updated monthly since December 2003. Quarterly summaries by site are used for high-level reports about ARM User Facilities by DOE to the Office of Management and Budget. ARM facility and operations managers use the more detailed measures to monitor and correct problems. The logic for the data delivery measure has been developed. The results are being formatted into a report format, and preliminary versions have been distributed to a limited part of the ARM operations group.

Performance in the area of Computational Climate Simulation was Outstanding. On Wednesday, June 23, 2004, a new vectorized climate model, the Community Climate System Model (version CCSM3) was publicly released. The vectorization work performed at ORNL was committed to the National Center for Atmospheric Research (NCAR) code repository at the beginning of June, even though the code release from NCAR did not meet its May 18, 2004, target. ORNL also supported NCAR simulations for the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment, by providing computing resources for the control simulation. ORNL continues to dedicate 12 nodes of the IBM Cheetah to this work and the ensemble simulations of the B1 Scenario. Results from this project have been posted on the Earth System Grid (ESG) for collaborators to examine.

Performance in Terrestrial System Ecophysiology of Carbon Cycle Change and Sequestration was Excellent. Model development and simulations that quantify the influence of climate and CO₂ on terrestrial system ecophysiology were completed, with voluminous and complex results. A short manuscript on some of the results was completed and submitted as a book chapter. A longer paper for the peer-reviewed literature paper was completed, but submission for publication was delayed by electronic difficulties.

Performance in Flux Tower Measurements of Carbon Cycle Change and Sequestration was Outstanding. The final document, “A Flux Atlas for Representativeness and Statistical Extrapolation of the AmeriFlux Network,” was delivered to DOE on April 28, 2004, both in hard copy and via a delivery Web site, <http://geobabble.ornl.gov/flux-ecoregions>. The Web site contains supporting information, such as a pan/zoom/scroll tool for viewing the input layers and flux ecoregions, animations, and downloadable digital versions of the final flux ecoregions.

Performance in Ozark Forests Measurements of Carbon Cycle Change and Sequestration was Outstanding to Excellent. A 32-m walk-up tower was constructed and eddy covariance and a CO₂ profile system were installed on the tower, as were sensors for measuring environmental variables. Soil respiration chambers and probes for monitoring whole-tree water use have also been successfully deployed. A communication package enables remote access to site-specific information. The forest floor monitoring system was deployed in April and the above-canopy flux system was fully operational on June 15, 2004, following weather-related delays. Since then, all major data acquisition systems have been running smoothly.

Data collected to date are yielding interesting scientific findings. For example, it was discovered that energy storage in chemical bonds, biomass, and canopy air space is a significant component of the energy budget at the Missouri Ozark site. This finding provides insight into the energy balance closure issue for the eddy covariance system. It was found that detailed profiling near the canopy bottom is important for estimating net ecosystem exchanges of carbon dioxide accurately. We will report these results at upcoming NACP and AmeriFlux meetings.

The Missouri Ozark site has already started to attract researchers from the upper Midwest region. A U.S. Department of Agriculture scientist started a stem respiration project at the site; a professor from the University of Illinois submitted a proposal to National Institute for Global Environmental Change to conduct isotope studies at the site; and requests have been received for collaborations from other AmeriFlux investigators. The project Principal Investigator was asked to coordinate flux studies in the upper Midwest region to support the NACP.

Performance in the Plan for Transition of FACE Site of Carbon Cycle Change and Sequestration was Outstanding. Following planning steps that included an evaluation of extending the vent pipe towers, discussions of follow-on projects that would support DOE objectives, and development of a time line for project closeout and transition to a new study, it was decided to continue the FACE experiment in the current mode. Tree growth has slowed in the last two years, so the concern about trees growing beyond the vent pipes has lessened. Leaf samples from the top of the canopy have been collected and submitted for ¹³C analysis as a measure of integrated CO₂ exposure. New scientific questions have emerged in the past year. The observation of a deeper root system in elevated CO₂ raises new questions about carbon, water, and nutrient cycling that should be pursued. A steeper decline in foliar nitrogen suggests that a negative feedback on productivity may be developing. Furthermore, several research groups have expressed interest in initiating new studies at the site. Hence, there is strong reason to continue the current study as long as feasible.

A renewal proposal will be submitted to DOE in December 2004, documenting current progress and results and describing new measurements to be made in 2006 and 2007. Depending on the results of an ongoing ancillary experiment on nitrogen nutrition, a new nitrogen manipulation in subplots of the current FACE plots may be proposed. A proposal for a new FACE experiment in an old-field setting will be developed at a future date.

Performance in Scaling Terrestrial Strategies of Carbon Cycle Change and Sequestration was Outstanding. A proposal for an integrated assessment of terrestrial carbon sequestration in six states was submitted to DOE, reviewed, and revised to increase its relevance to the NACP and reduce the emphasis on assessment. A journal article, "Carbon Sequestration Enhancement in U.S. Soils," has been accepted for publication in *BioScience*.

Performance in the operation of CDIAC was Outstanding. Monthly estimates of U.S. CO₂ emissions from fossil-fuel consumption have been generated and are now available, as are monthly isotopic records of ¹³C/¹²C ratios from U.S. fossil-fuel use. The compiled records cover the period from 1981

to 2002 and may be found on the CDIAC Web site. These records, derived from fuel consumption data published by the DOE's Energy Information Administration (EIA), provide the first long-term time series of monthly U.S. fossil-fuel CO₂ releases and isotopic signatures. They will greatly benefit global change researchers and programs needing fossil-fuel CO₂ emission estimates with finer temporal resolution. Preliminary results and analysis of the annual cycle were presented at the annual American Geophysical Union meeting in San Francisco during December 2003. A manuscript summarizing the monthly results and methodology has been accepted by *Tellus* and should be published in late 2004.

Estimates of state-level fossil-fuel CO₂ emission and per capita estimates have been generated from EIA data on state-level energy production and consumption for all 50 states and the District of Columbia. These records will aid programs, such as NACP, that need reporting of U.S. emissions on finer spatial scales and studies evaluating carbon mitigation strategies. A manuscript summarizing the records and methodology has been accepted by the *Journal for Mitigation and Adaptation Strategies for Global Change*. State-level fossil-fuel CO₂ emission and per capita estimates are available on the CDIAC Web site.

Rating: Outstanding

7. Support the missions of the Remediation Sciences Division through use of our core capabilities in biogeochemistry, chemical sciences, computational sciences, ecology, geochemistry, geosciences, hydrology, microbiology, stewardship science, and separations science.
 - Prepare a plan to expand field research facility concepts within the ORNL Environmental Park to focus on science and stewardship needs consistent with ERSD Draft Strategic Plan.
 - Continue outstanding operation of the NABIR FRC
 - Provide support to three multi-disciplinary field research teams.
 - Provide FRC contaminated and background sediment and groundwater samples, along with humic material concentrated from Background Site soils, to NABIR and GTL researchers.
 - Provide information to NABIR Researchers by maintaining the FRC website and database and organizing the annual FRC Workshop at ORNL.
 - The FRC will include stakeholder outreach and communication activities (e.g., brochures, fact sheets, and Web site) and will include educational outreach through the hiring of student/teacher interns.
 - Submit three key publications from the NABIR projects (Sorption and Binary Exchange of Nitrate, Sulfate, and Uranium on an Anion-Exchange Resin; Characterization of Microbial Biomass from a Denitrifying Fluidized Bed Reactor for the Reduction of Uranium (VI); Coupling of Functional Gene Diversity and Geochemical Data from Environmental Samples Using Artificial Neural Networks).
 - Complete field work at the Jardine EMSP WAG site prior to site closure; re-scope project to focus on long-term monitoring science as the site is capped and closed.
 - Submit three key publications from EMSP Projects focusing on the Hanford Vadose Zone (coupled hydrological and geochemical processes governing the transport of Co(II)EDTA through the Hanford vadose zone; fate and transport of Uranium in undisturbed cores from the Hanford formation; influence of coupled processes on the fate and transport of Sr and SrEDTA through the Hanford formation).

Results: A plan for expanding the Field Research Center (FRC) facilities was presented to DOE managers in June 2004. Reactions to our ideas have been very positive, although there has been no opportunity as yet to submit a proposal for FRC expansion. Excellent progress was made on operation of all FRC projects, setting up project infrastructure, and producing scientific output. A peer review

of FRC operations in August 2004 yielded very positive results. All objectives in providing support to multidisciplinary research teams were achieved.

ORNL coordinated FRC Working Group activities and submitted to DOE a revised draft of the NABIR FRC Conceptual Model, detailing the hydrological, geochemical, and microbial processes that control the fate and transport of contaminants in Areas 1, 2, and 3 of the FRC and the background area. Progress reports were received in September from the working group leaders and a new draft of the FRC Conceptual model was posted on the Web site. Improvements were made to the FRC flow and transport model, and a comparison of simulated uranium breakthrough results to column studies demonstrated excellent correlation between model predictions and observations.

Significant progress was made in conducting Phase 1 work described in the Addendum to the Site Characterization Plan. Characterization of new FRC Areas 4 and 5 indicated that both areas have sufficiently high concentrations of contaminants to be suitable for NABIR or EMSP research.

Sediment and groundwater samples were distributed to a number of institutions throughout the year. ORNL staff collaborated with researchers from the Idaho National Engineering and Environmental Laboratory to deploy and retrieve new sets of coupons or “bug traps” in Area 3 and the Background Area. Hundreds of ICP/MS analyses were conducted to support collaborating researchers. We are continuing work on the extraction of FRC humic materials.

The FRC Web site was revised and reorganized to improve access by researchers, to enhance stakeholder access, and to reflect the focus on the four new Working Groups. Presentations from the September FRC Workshop and tour were posted. In addition, a newsletter was produced and distributed. At year’s end, preparations were for the annual FRC Workshop and tour, scheduled for October 18–20, 2004, were under way.

Four publications were completed, exceeding the goal of three. One has been published, one has been accepted for publication, and the others are in review.

Field work at Waste Area Grouping (WAG) 5 was completed and data analysis is continuing. The site is now under active remediation by Bechtel Jacobs Company, LLC, so the Field Work Proposal (FWP) for this project has been refocused to encompass long-term stewardship and monitoring issues associated with contaminated sites. In April, ORNL presented proposed new research on long-term stewardship issues on the Oak Ridge Reservation to BER staff; the proposed work was well received and found to be acceptable within the context of the EMSP. Funding will continue into the next fiscal year and is expected to continue for several more years. The FY 2004 project work was completed, and the publication of results is in progress.

Two publications on EMSP projects are in press; a third is being substantially revised in response to reviewer comments. A fourth publication is on hold pending collection of additional core data.

Rating: Outstanding

Office of Science: Office of Advanced Scientific Computing Research

1. Provide leadership in high-performance computing, networking, computer science, applied math, computational science, theory, and experiments to deliver outstanding science and new technology.
 - Evaluate new and emerging hardware for scientific applications; negotiate procurement and begin evaluation of potential leadership class system.

- Provide support for SciDAC applications as the principal resource for computer science and computational science research.
- Improve network communications.
- Implement CCS user program.

Results: ORNL demonstrated leadership in high-performance computing by enhancing the accessibility of high-performance computing capability, both within the Laboratory and for our external partners. Several notable accomplishments illustrate our progress in becoming a world leader in harnessing computing power as tools of scientific discovery.

In May 2004, the Secretary of Energy announced that ORNL won the competition to build the fastest computer in the world open to all users, and that it would housed in ORNL's National Leadership Computing Facility (NLCF). Over the next five years, it is anticipated that building this computer will cost an estimated \$150-200 million. The secretary noted that this facility would "Deliver major research breakthroughs, significant technological innovations, medical and health advances, enhanced economic competitiveness, and improved quality of life for the American people." ORNL assembled an impressive team to prepare the successful proposal, involving staff from ORNL and other national laboratories and high performance computing centers; the team members represented applications disciplines including climate change, astrophysics, nanoscience, biology, and fusion. Science teams defined requirements for leadership computing and breakthrough science, while staff with expertise in hardware and software, scientific visualization, educational outreach and university relations worked together to develop a proposal to revitalize scientific computing and competitiveness in the U.S. Letters of support came from more than 80 universities, industries, national laboratories and computing centers. Other developments to support this terascale computing center include:

- The Scalable System Software project has gotten DOE centers, NSF centers and industry to agree on standardized interfaces between system components and begun producing a compliant, fully integrated suite of systems software that can be used across all the terascale computer centers for the cost effective management and utilization of their computational resources.
- The Common Component Architecture project is providing tools for managing the complexity of large-scale scientific simulations to increase the productivity of software developers. Early adopters include quantum chemistry, global climate, and the SciDAC Computational Facility for Reacting Flow Science (CFRFS), which is now publishing scientific results derived from CCA-based simulations.
- Development of a fault tolerant version of MPI allows a user to recover from a failed process and continue execution of the application. Terascale systems may have thousands of processors, shortening the "mean time to failure" dramatically, and making fault tolerant applications vital to productivity.
- A number of projects are involved in developing tools for managing, mining, and visualizing the massive amounts of data generated by terascale machines. The projects/tools include: Earth System Grid, Scientific Data Management (Parallel-R, ASPECT), and Multi-lab Accounting and Allocation Manger.
- A number of projects are involved in development of improved algorithms and mathematical methods for more efficient numerical solution of the physics involved in large-scale science applications. These include numerous improvements for boundary integrals and moving boundary problems (application to flow models, electronic device fabrication), non-local coherent potential approximation (NLCPA), Green's function, Level Set method, fast volume integration based on FFT, ADI-like preconditioners for 1DBOLTZTRAN (astrophysics), and many more.

The Cray X1 system was expanded from 128 to 256 processors as an initial step toward fulfilling the mission of the NLCF. The system completed acceptance testing on time, exceeding a demanding set

of requirements. An external review was held by DOE's Office of Advanced Scientific Computing Research and received a highly complimentary report. Expanded collaborations are under way with Cray for testing scalability and the operating system, and proof-of-principle computations were performed for fusion simulations and materials science.

- In a global ocean simulation, the Cray X1 achieved 50% higher simulation throughput than the Japanese Earth Simulator for an equal number of processors.
- A fusion application, global GYRO transport, runs up to 20 times faster, allowing simulations to fully resolve questions raised in prior studies.
- The AGILE-BOLTZTRAN and VH-1 astrophysics computational kernels both run 15 times faster than on the previous best systems.
- Large-scale simulations of high-temperature superconductors run 25 times faster than previously achieved.

In collaboration with Silicon Graphics, Inc. (SGI), ORNL evaluated the Altix system (256 processors, shared memory, single copy of the operating system). Work at ORNL dramatically increased the stability of the Altix system, which passed its acceptance test. The system was upgraded to the latest high-speed Intel processors. The high performance of the Itanium processor and the large shared memory has proven to be a powerful combination for important codes that do not currently scale well on distributed memory systems.

ORNL was the first DOE laboratory to begin evaluation of the next-generation "Federation" interconnect on the IBM Power4 Regatta H system, Cheetah. The transition to this interconnect is expected to be completed by January 1, 2005.

The production systems in ORNL's Center for Computational Sciences (CCS) delivered 65,147,457 MPP hours, exceeding the goal of 55,000,000 MPP hours by the end of the fiscal year. The evaluation systems have delivered an additional 38,163,184 MPP hours for a total on all systems of 103,310,640 MPP hours. The vast majority of the user community comes from outside of ORNL, with more than two-thirds of the users remotely accessing the resources. CCS is providing significant computing resources for the Intergovernmental Panel on Climate Change (IPCC) simulation runs.

The volume of data stored in the ORNL Mass Storage System continues to grow at a rate of 18 terabytes per month, with over five million files and 375 terabytes of data, doubling the annual volume. The data storage rate is expected to exceed this trend in the next fiscal year. ORNL has doubled the disk cache, added data movers, and upgraded the Hierarchical Storage Interface to increase overall effectiveness and speed.

EVEREST, the Exploratory Visualization Environment for Research in Science and Technology, provides an immersive, 35 megapixel powerwall display for production visualization. The heart of EVEREST is a parallel imaging system capable of mirroring the scale of the massive data sets generated in science and engineering simulations, geographic information systems, and other sensor and experiment data streams.

SciDAC runs using CCS resources have resulted in a number of scientific advances:

- The new coupled climate system model, CCSM3 was released in June 2004, culminating a focused effort with our NSF sponsored collaborators at NCAR.
- AOMIP studies of the Arctic Ocean currents were the first climate science runs on the Cray X1.
- ORNL has worked closely with NCAR, LLNL, and Argonne National Laboratory (ANL) to implement a compact chemistry scheme in the atmospheric model to study sulfur, carbon and ozone interactions with the climate system.

- A surface ocean ecosystem model was introduced into two global numerical models of ocean circulation. This new biogeochemistry in the POP code has allowed successful simulation of DMS (di-methyl sulfates) output from the ocean in runs on ORNL's IBM Power4, Cheetah.
- A peer review of the SciDAC Climate Consortium, held October 2003, was very favorable: "...this capability is becoming a national asset."
- Using the Cray X1 at the CCS, materials researchers have been able to perform computations with significantly larger clusters. Combined with new algorithmic developments using Dynamical Cluster Approximation (DCA), a clear path has opened to solving the quantum many-body problem for high-temperature cuprate superconductors (HTSC).
- TeraScale Supernova Initiative (TSI) researchers completed the first stellar core collapse simulations performed with state of the art neutrino transport and state-of-the-art nuclear structure physics.
- TSI researchers performed general relativistic collapse and postbounce simulations with Boltzmann neutrino transport and a "hybrid" electron capture model. The results are now motivating neutrino-nucleus cross section measurements, and proposed neutrino experiments at the SNS. This work also led to publication of two *Physical Review Letters*.
- A data pipeline was created to move TSI data from supercomputers at CCS and NERSC to the nodes of the TSI visualization cluster at NCSU. This allows interactive visualization of data sets as large as a billion zones.
- A new 3-D hydrodynamics simulation of stationary accretion shock instability (SASI) is under way on the Cray X1 with data being uploaded to the Logistical Network and shared with collaborators across the country.
- The Fusion project suite of all-orders spectral algorithm (AORSA) full-wave codes has been sped up by several orders of magnitude through implementation of advanced optimized algorithms. The new formulation transforms the linear system from Fourier space back to configuration space, condensing the solution matrix and leading to an over 100 fold speed up in the ScaLAPACK parallel linear solver and an overall 27 fold speedup in a three-dimensional calculation.

ORNL improved access to its resources by signing a Memorandum of Understanding (MOU) with National LambdaRail (NLR) to upgrade connectivity on NLR fibers to PNNL and the San Francisco Bay area and by partnering with the NSF TeraGrid to link its Atlanta hub to ORNL's neutron science facilities.

ORNL's design of the backbone for the Ultrascale Science Research Network consisting of dual 10 Gbps lambdas has been completed, and utilizes the ORNL network infrastructure from Oak Ridge to Chicago, and NLR from Chicago to Sunnyvale. The design has attracted considerable attention, and the authors have given invited papers at the Geneva GNEW conference in March, as well as the NASA Optical Technology Workshop at Ames Laboratory in August. The first phase of the procurement has been completed and the first phase of connectivity from Oak Ridge to Chicago to be followed by testing and then full deployment with 20 Gigabits this fall.

In addition to these programs funded to improve/increase network connectivity and bandwidth, ORNL has projects aimed at improving throughput and reliability of both new and existing connections.

- The Net100 project has demonstrated an order of magnitude improvement in network performance with no changes to the network application. The goal of Net100 is transparent tuning of legacy scientific network applications using knowledge about the network path and incorporating the latest improvements in network transport protocols. Net100 software is able to

tune each network application separately, based on the network path and quality of service desired.

- Using Net100 instruments the Network Dynamics project has developed methods that achieve provable stable transport streams with predictable end-to-end delays. This is vital for applications that require control of processes over wide-area networks for tasks such as computational steering, remove interactive visualization, and instrument control.

ORNL's Computing and Computational Sciences Directorate also expanded the application of computational sciences to national security and energy, with support to programs outside DOE's Office of Science.

The SensorNet program has been successful in securing the initial funding base to define, develop, and start testing the architecture and framework for sensor networks based on open standards that are scalable across local, regional, and national applications. Working with industry, academia, and other federal agencies, the ORNL effort is providing leadership in defining international standards for sensor networks. The research and development is being operationally evaluated in several test beds across the country.

- Successfully developed prototype mobile deployable unit in FY 2004.
- Successfully implemented five SensorNet nodes at Fort Bragg.
- Developed a strategic alliance with NIST and OGC standards committees.
- Initiated first technology transfer actions with ORNL Office of Technology Transfer during FY 2004.

CSED staff have been actively involved in helping develop capabilities for the DOE Office of Energy Assurance to respond quickly to high level decision makers during national energy-related events. Working with other national laboratories, ORNL staff have coauthored an evaluation report on modeling, data, and visualization needs to support DOE OEA missions. In addition, the national laboratories team has collectively and successfully carried out several demonstrations of capabilities for rapid response, including several actual events related to the hurricanes that passed through Florida this year.

- Obtained strategic initial funding from DOE Office of Energy Assurance.
- Supported OEA in multilaboratory demonstrations of DOE capabilities.
- Captured key roles in modeling related to population, transportation, and communication infrastructures.

CSED staff have been actively engaged in working with key Department of Homeland Security (DHS) S&T program managers to develop planning documents in the area of knowledge extraction from disparate data sources and the related information technology issues. The scientific areas targeted are large-scale data analysis, advanced scientific computing, cyber security, sensor networking, critical infrastructure protection, behavior modeling, population dynamics, facility vulnerabilities, and transport of hazardous materials in water.

- Captured and initiated multiple new projects in FY 2004 with several directorates within the Department of Homeland Security (DHS).
- Obtained key roles for laboratory personnel on DHS committees.

The Computational Sciences and Engineering Division's (CSED) Center for Musculoskeletal Research supported 30 students under Center funding during FY 2004 and developed strategic relationships with commercial partners for technology transfer throughout FY 2004.

CSED has provided the Nuclear Regulatory Commission with key data related to national issues on reactor pressure vessel performance and lifetime estimates.

A CSED staff member was selected as deputy director of the new Southeastern Regional Research Center of the National Security Agency's Advanced Research and Development Activity.

Rating: Outstanding.

2. Provide information technology (IT) productivity and services including IT modernization.
 - Implement enhanced cyber security for ORNL systems.
 - Implement Outlook/Exchange.

Results: ORNL provided enabling IT infrastructure and services including IT support for facilities modernization. Key accomplishments include the following:

Enhanced ORNL cyber security

- Developed and received approval for certification and accreditation documentation for all unclassified ORNL IT systems.
- Developed new capabilities for managers and Division Cyber Security Officers to assess the cyber security risk of their organizations and to take steps to mitigate the risk.
- Implemented a new wireless network security model to enhance access protection for internal staff and visitor public wireless access.

Implemented Outlook/Exchange

- Completed implementation of Outlook for the Laboratory's email infrastructure ahead of schedule.
- Successfully rolled out Outlook calendar for Laboratory-wide use.

Continued safety awareness and operational self-assessments.

Rating: Outstanding.

Office of Science: Office of Fusion Energy Sciences

1. Complete all preparations for Critical Decision 1 for the Quasi-Poloidal Stellarator project (September 30, 2004).

Results: All documentation for Critical Decision 1 (CD-1) approval was completed in January 2004. At the end of May 2004, DOE approved Critical Decision 1 for the QPS project, and set the cost range for QPS at \$24 million to \$29 million, subject to funding availability in the Congressional budget. At the beginning of August, a contract was awarded for fabrication of a highly accurate, complex, stainless-steel cast form on which a nonplanar prototype QPS coil will be wound in FY 2005.

Rating: Outstanding.

2. Complete first phase of irradiation testing in HFIR to evaluate the effects of neutron bombardment on the microstructural evolution and property changes of leading candidate fusion materials (September 30, 2004).

Results: The DOE/JAERI collaboration is carrying out a series of irradiation experiments in the HFIR to investigate the properties of several advanced, low-activation ferritic and ferritic-martensitic steels. The first phase of these experiments, on specimens of International Energy Agency (IEA) reference heat of alloy F82H, was completed on September 28, 2004.

Changes in the strength of specimens irradiated at 300°C to ~7 dpa, are summarized in Table I.2, and ductility parameters for the unirradiated and irradiated material are given in Table I.3. The loss of ductility resulting from increased strength is striking, with the uniform elongation reduced to nearly zero. A loss of work hardening ability is shown by the reduction in the ratio of the ultimate tensile strength to the yield strength. The reduced elongation is evident in the degree of necking observed in the broken tensile specimens shown in Figure I.1.

Table I.2. Change in strength properties for IEA heat of F82H irradiated at 300°C to 7 dpa

Change in yield strength	264 MPa
Change in ultimate strength	201 MPa
Change in Vickers hardness	51 DPH

Table I.3. Ductility parameters for IEA heat of F82H

	Uniform elongation (%)	Total elongation (%)	Ratio of ultimate strength to yield strength
Unirradiated	9.4	19.1	1.17
Irradiated at 300°C to 7 dpa	0.3	8.8	1.04

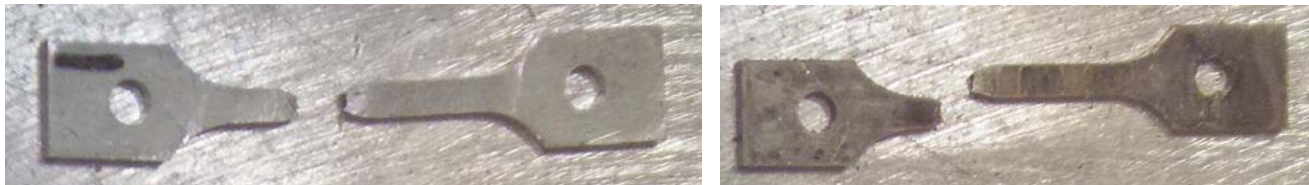


Figure I.1: Unirradiated control specimen (left) and specimen irradiated at 300°C to 7 dpa in HFIR (right)

Rating: Outstanding.

Office of Energy Efficiency and Renewable Energy

1. Distributed Energy Resources

Complete benchmark testing of a microturbine generator in a CHP system at the ORNL Cooling, Heating, and Power Integration Laboratory User Center. Test data will be used to develop and validate a computer algorithm that can be used to optimize performance (September 2004).

Results: The benchmark testing of a Capstone 30-kW microturbine generator in a combined heating and power (CHP) system at the ORNL Cooling, Heating, and Power Integration Laboratory User

Center has been completed. The modeling for microturbine and gas turbine prime movers has been completed and calibrated with sample runs from both the ORNL CHP Integration Laboratory (Capstone 30-kW microturbine generator) and with data from Solar Turbines, a major gas turbine vendor. Modeling of exhaust-to-hot-water and exhaust-to-steam heat exchangers has been completed and calibrated. Modeling of single and double effect absorption chillers has been performed. The single-effect absorption chiller model has been calibrated with sample runs from the ORNL CHP Integration Laboratory. The model was demonstrated to program sponsors on August 25, 2004.

Rating: Outstanding.

2. Industrial Technologies

Complete thermomechanical processing base studies of industrial scale heats of new ORNL-developed tungsten (W) and tantalum (Ta) nanostructured reinforced steels for plate and tube applications (June 30, 2004).

Results: The melting of two industrial scale heats of ORNL-developed compositions was completed. The cast ingots from each of the heat has been thermomechanically processed into slab, plates, forgings, and tubing. Mechanical testing of the products is under way. The creep-rupture strength (105 h ~10 years) of the ORNL alloy is higher than that of the strongest commercially available alloys. The newly developed ORNL alloys can be produced successfully into various product forms with existing commercial equipment. Furthermore, the properties of the newly developed alloys are consistent with the objectives set for this project.

Rating: Outstanding.

3. Hydrogen, Fuel Cells, and Infrastructure

Develop and manufacture nitride metallic bipolar plates for fuel cell testing at Los Alamos National Laboratory, General Motors (GM), and at least one fuel cell manufacturer (September 30, 2004).

Results: ORNL has expanded its collaborations with industrial partners for both manufacturing and testing of nitride metallic bipolar plates. Haynes International and Allegheny Ludlum provided ORNL with sheets of commercially available Ni-Cr and stainless steel alloys for rolling/stamping and nitridation evaluation and fabrication of fuel cell plates. The Haynes G-35 and Allegheny Ludlum Al 294C were tested at ORNL and found to have good corrosion resistance and electrical properties. ORNL manufactured and delivered plates of nitrided Ni-50Cr model material to three industrial partners: General Motors, Fuel Cell Energy Inc., and Los Alamos National Laboratory (LANL) for fuel cell testing. To date, the plates have undergone more than 5,000 hours of continuous corrosion testing at LANL without any failures while maintaining superior electrical conductivity to machined graphite. The GM plate is completing its test, the Fuel Cell Energy Inc. plate is in testing, and work at LANL is delayed by the shutdown of that laboratory.

Rating: Outstanding.

4. Office of Electric Transmission and Distribution

- In partnership with key stakeholders, prepare a draft T&D materials business plan (September 30, 2004).
- Engage one new U.S. company in research at the Powerline Conductor Accelerated Test facility (September 30, 2004).

Results: A draft transmission and distribution (T&D) materials business plan was prepared for review with DOE sponsors on June 30, 2004.

A new Southwire conductor with embedded optical fibers for temperature measurement was installed at the Powerline Conductor Accelerated Test (PCAT) facility in April. The embedded fibers and associated instrumentation enable measurement of conductor temperature with data points spaced two meters apart on critical transmission spans. Testing was conducted from May 7 to June 17, with 300 hours of system operation.

Rating: Outstanding.

5. FreedomCAR and Vehicle Technologies
Place the order for the next generation P4 Preforming Machine (June 30, 2004).

Results: Through extraordinary efforts by ORNL legal, procurement, and technical staff, a contract was placed with Aplicator System AB, Stockholm, Sweden, by June 29, 2004, for a next-generation Programmatic Powdered Preform Process (P4) machine, shown schematically in Figure I.2.

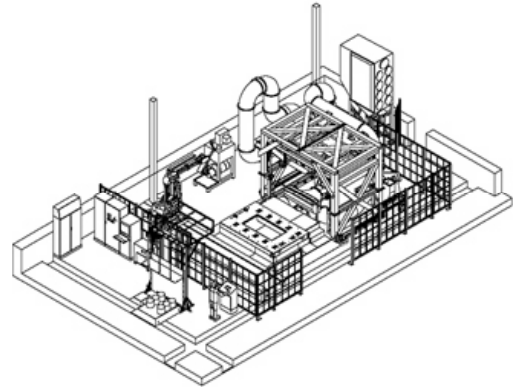


Figure I.2. The next-generation preforming machine being constructed by Aplicator Systems AB for the Automotive Lightweighting Materials Program.

P4 is the most viable candidate process for making carbon-fiber preforms for a variety of automotive body components. The Automotive Composites Consortium (ACC), with support from DOE and carbon fiber manufacturers, is transitioning P4 to carbon fiber. Many features of the process are not well understood and require more study to effectively chart the development path for carbon fiber-based preforming. With this equipment, ORNL will be able to conduct the needed developmental research and address the technology barriers to the implementation of cost-effective carbon-fiber composite processes for transportation and related applications. The P4 preforming machine will also serve as a base system for R&D on next-generation chopper guns (e.g., for hybrid glass-carbon fiber and reinforced thermoplastic fiber preforms) for eventual transfer to industry.

Rating: Outstanding.

Office of Fossil Energy

1. An inorganic hydrogen separation membrane prototype will be submitted to DOE for classification and nonproliferation reviews. This is the process by which products fabricated by a classified process are declared unclassified and approved for release and use (January 2004).

Results: An inorganic hydrogen separation membrane prototype was submitted to DOE for classification and nonproliferation reviews on January 16, 2004. The membranes were determined to be unclassified and were approved for extended unclassified development and demonstration on July 9, 2004.

Rating: Outstanding.

2. Development of the ORNL electromagnetic acoustic transducer in-line pipe inspection tool will be completed and will be available to NETL for demonstration at a pipeline facility selected by NETL to verify the ability to detect and characterize pipeline flaws (July 2004).

Results: The electromagnetic acoustic transducer in-line pipe inspection tool was made available to the National Energy Technology Laboratory (NETL) on schedule in July 2004. The final test was

conducted during the week of September 13, 2004, at the Battelle facility in Columbus, Ohio. The transducer performed very well in the test.

Rating: Outstanding.

3. A topical report on the synergies between aromatic compound formation and/or mitigation and the removal of sulfur and other heteroatoms will be prepared to aid refiners in the development of strategies to enhance the hydrogenation capabilities of their existing refinery processes. These new strategies will be required to meet, for example, new EPA diesel regulations in 2010 (September 2004).

Results: A topical report on the synergies between aromatic compound formation and/or mitigation and the removal of sulfur and other heteroatoms was prepared and submitted to DOE on September 30, 2004.

Rating: Outstanding.

4. Experiments to determine the densities of CO₂-CH₄ mixtures at 30 to 40°C and 10 to 200 bar will be completed. The new data will be used to develop mathematical expressions for application in numerical modeling of the processes and parameters that affect capture and retention of CO₂ in subterranean coal layers (February 2004).

Results: Experiments to determine the densities of CO₂-CH₄ mixtures at 30 to 40°C and 10 to 200 bar were completed on schedule in February 2004. The new data are being used to develop mathematical expressions for application in numerical modeling of the processes and parameters that affect capture and retention of CO₂ in subterranean coal layers.

Rating: Outstanding.

Office of Nuclear Energy, Science and Technology

1. Issue interim report on cross cutting candidate materials for high-temperature and radiation service in the Next Generation Nuclear Plant (NGNP, August 31, 2004).

Results: The Updated Generation IV Reactor Integrated Materials Technology Program Plan (ORNL/TM-2003/244/R1) was submitted on August 31, 2004. The report provides a summary of all the reactor-specific and National Hydrogen Initiative (NHI)-related material candidates and research, as well as those for the crosscutting area.

Rating: Outstanding.

2. Complete deposition of coatings meeting the AGR-1 Fuel Product Specification on 500-μm diameter depleted UO₂ kernels. (August 31, 2004)

Results: Deposition of coatings was completed in August 2004. The documentation package was submitted on August 30, 2004 and outlined the processes to coat the kernels. This work represents the first phase of a three-step effort to develop fuel for irradiation testing in the Advanced Test Reactor (ATR) in FY 2006.

Rating: Outstanding.

3. Develop and test advanced aqueous separations processes applicable to the treatment of current and advanced light water reactor spent fuel and evaluate separations processes for Generation IV reactors and test when technology sufficiently matures (September 30, 2004).

Results: *Am-Cm Recovery Hot Tests*: Hydroxide precipitation/selective redissolution hot tests were completed.

A small hot cell experiment (A1-APD-1) was carried out to evaluate a precipitation process to purify americium, curium, and rare earth (RE) elements from impurities and then separate the americium from the curium and RE elements. Radiochemical analysis of the precipitate from the experiment showed that although we had a container full of solids, the solids did not contain the americium, curium, or RE elements. We suspect that the heating step may have driven NH_3 from the solution and lowered the pH enough to keep the actinides and RE elements in solution. An evaluation is in progress to determine whether to repeat the test with a revised procedure. A summary report on the evaluation of the americium-curium separation processes was completed. (*Summary of Actinide and Lanthanide Separation Studies for Spent Fuel Processing*, August 31, 2004).

Conversion of the Pu-Np Product to Oxide via the MDD Process: The procedure for operation of the modified direct denitration (MDD) equipment in the glove box was completed and approved. Final checkout of the equipment after the glove box was completed with no additional issues or corrections. The hot cell operations group is preparing the plutonium/neptunium product solution from the co-decontamination demonstration for transfer from the hot cells to the glove box laboratory. A procedure for preparing a plutonium/neptunium oxide via oxalate precipitation is in progress. This activity will follow the preparation of oxide by the MDD process.

Advanced head-end disassembly and voloxidation: Laboratory experiments on volatilization of molybdenum and technetium (or rhenium) were completed on August 16, 2004.

Generation IV Fuel Treatment: Fuel compacts fabricated from depleted uranium have been located at ORNL and will be used for dissolution tests. A report summarizing the leaching-dissolution proof-of-principle experiments was completed on August 31, 2004.

Engineered Product Storage: The properties of uranium recovered from spent fuel are being compared to the waste acceptance criteria for the Nevada Test Site and Envirocare. The results are being compiled into a report. A draft final report on uranium storage concepts was completed on August 24, 2004.

Rating: Outstanding.

4. Maintain and operate isotope facilities in a safe and environmentally sound manner for the continued production, packaging and shipment of isotopes and meet customer specifications for 98% of isotope products and services delivered and achieve an on-time delivery of 95% for radioactive isotopes and 97% for stable isotopes (September 30, 2004).

Results: Isotope production activities have achieved the outstanding performance.

- Customer specifications were met on 276 of 277 orders (99.6% versus a 98% goal).
- Shipments of radioisotopes were made on time for 119 of 122 orders (97.5% versus a 95% goal).
- Shipments of stable isotopes were made on time for all 155 orders (100% versus a 97% goal).
Three shipments were delayed at the request of the customer and are not included in these results.

Rating: Outstanding

5. Support the new contractor performing Phase I, Planning and Design, of the ²³³U Disposition, Medical Isotopes Production, and Building 3019 Complex Shutdown Project. Support shall be timely and include such things as supporting facility access, making current and historical design and safety basis documentation available, and performing independent design and constructability reviews of the proposed processing equipment and facility modifications (September 30, 2004).

Results: ORNL completed several tasks in support of Isotek, the project contractor:

- Conducted several tours of Isotek, DOE, and DNFSB personnel.
- Completed review of Isotek's 60% Design.
- Processed requests for information covering a wide range of subject areas.
- Held additional meetings (both internal and with Isotek) on loaning of UT-Battelle personnel for a period of up to one year after the transition date.
- Distributed revised drafts of the Transition Agreement for comments.
- Continued cleanout of two laboratories after reaching agreement with Isotek on need for equipment in those laboratories.
- Reviewed preliminary versions of the Isotek Issues Database.
- Continued to look for potential users of the unused manipulator boxes in Cell 2. Completed the estimate to remove the cell windows and manipulators from these unused manipulator boxes for use at other ORNL facilities.
- Sent a draft FY 2005 Project Management Plan for UT-Battelle activities/interfaces with Isotek through the Transition Date (currently projected as March 1, 2005) to DOE for comment. Comments were incorporated and a revised draft was distributed.
- Drafted a business case outlining rough order-of-magnitude (ROM) costs for UT-Battelle to reconstitute and implement repackaging for long-term storage. The draft was revised and redistributed.
- Held a scoping meeting for Isotek to discuss cyber security and network needs with responsible UT-Battelle personnel.
- Initiated conceptual design and estimate for a storage building to hold downblended material.

Rating: Outstanding.

National Nuclear Security Administration: Office of Defense Nuclear Nonproliferation

1. Place at least one contract (general ordering agreement) to construct a central storage facility at one of the sites of the Nuclear Weapons Complex in Russia for the DOE/NNSA NA-25 Material Protection, Control, and Accounting (MPC&A) Program.

Results: ORNL had the lead role for implementation of safeguards and security systems at 7 of 11 Russian sites within the Nuclear Weapons Complex Division of the MPC&A Program (NA-25). Significant quantities of strategic nuclear materials, such as plutonium and highly enriched uranium (HEU), were stored in outdated facilities at these sites. It was decided that consolidating strategic nuclear materials into a single modern storage facility at each site was preferable to attempting to improve safeguards and security at multiple outdated facilities. ORNL was tasked to contract with several sites to plan, design, and construct these consolidated central storage facilities.

ORNL provided technical oversight for these contracts. Technical experts and contract officers from ORNL worked with representatives from DOE Headquarters, the sites, the Ministry of Atomic

Energy in Russia (Minatom), and, following administration changes within Russia, a newly formed Federal Agency for Atomic Energy (Rosatom) that replaced Minatom.

U.S. and Russia technical experts reached agreement on the construction of a storage facility at the Chelyabinsk-70 facility within the closed city of Snezhinsk. At year's end, this \$17M contract detailing the construction parameters was on hold pending resolution of assurance issues at the governmental level. These issues included access to the facility once construction is completed (interim inspections during construction were already agreed upon) and access to existing storage facilities once material is removed (to ensure that consolidation is occurring).

Contract negotiations for the construction of a new plutonium storage facility at the Krasnoyarsk-26 (K-26) site within the closed city of Zheleznogorsk were completed. The K-26 facility did not face these same assurance issues of the Chelyabinsk-70 facility since the storage items were materials only. The K-26 site, with the concurrence of NNSA and Rosatom agreed to the terms and conditions of the contract. This represents a major step forward in securing this weapons-usable plutonium. The amount of material needing secure storage exceeded the capacity of the existing storage facility; materials were being stored in an ad hoc storage location with less than adequate safeguards and security.

Rating: Outstanding.

2. Support DOE/NNSA NA-243 Office of International Safeguards preparations for implementing the U.S.-IAEA Additional Protocol through (1) constructing and releasing an Additional Protocol Reporting System (APRS) for beta testing and (2) conducting an inspection field trial at the ORNL HFIR/REDC complex.

Results: Implementation of a new Additional Protocol (AP) treaty between the International Atomic Energy Agency (IAEA) and the United States will be an important tool for halting the proliferation of nuclear weapons and uncovering clandestine weapons programs. A critical component of this effort, assigned to ORNL, is the development of the DOE AP Reporting System (APRS). The APRS will be used to collect, review, and ultimately submit DOE declaration information to the IAEA.

The APRS consists of a series of modules that include stand-alone tools based on personal computers for use at DOE locations and an online central database for use by DOE-HQ. Beta versions of the modules are currently in beta testing. The initial version of the DOE AP public Web site (<http://www.ap.doe.gov>), which will be used to distribute the modules and provide additional information, was reviewed by NA-243 and completed in June.

A highly successful U.S.-Only AP Field Trial was conducted at the HFIR/Radiochemical Engineering Development Center (REDC) complex at ORNL in November 2003. The final report (*U.S. Only Field Trial for Additional Protocol Complementary Access*, ORNL/TM-2003/282), was completed by December 31, 2003, reviewed by NA-243, and released for publication March 31, 2004. The results from the field trial were incorporated into government policy guidance regarding U.S. implementation of the AP. More than 12 hours of videotape generated from this field trial will be incorporated into the outreach and training effort for the U.S. AP that is being coordinated by NA-243.

Rating: Outstanding.

3. Integrate preparations for the installation of the Blend Down Monitoring System (BDMS) at the Siberian Chemical Enterprise in Seversk, Russia. The three elements of this project are:
 - Complete certification package to Seversk for GAN approval of new Blend Down Monitoring System (BDMS).
 - Provide training for Russians in Oak Ridge on the Seversk BDMS.
 - Ship BDMS to Seversk, Russia.

Results: The HEU Transparency Implementation Program (NA-232) is responsible for monitoring the downblending of highly enriched uranium (HEU) from Russian dismantled weapons to low enriched uranium (LEU). The LEU is then shipped to the United States for use in light water power reactors, supplying about 50% of U.S. LEU requirements.

ORNL was responsible for the integration of the activities among the involved DOE laboratories and preparation for the installation of a Blend Down Monitoring System (BDMS) at the Siberian Chemical Enterprise (SChE) in Seversk, Russia. The BDMS continuously monitors the flow and enrichment of HEU (as UF₆ gas), a blend stock, and LEU as the downblending occurs. BDMS milestones included the preparation of the certification package to obtain Gostatomnadzor (GAN) approval for the installation of BDMS; training of SChE personnel in the installation, operations and maintenance of BDMS; and packing and shipping of 37 crates of equipment to Russia. All were completed on schedule. Installation at SChE was scheduled for October, thereby meeting a Secretarial commitment to the President.

Rating: Outstanding.

4. Test a detection concept for either fissile materials or chemical detection that can be used to identify the origins of nuclear materials to support nonproliferation missions.

Results: The NNSA Office of Nonproliferation Research and Engineering (NA-22) conducts applied research and development, testing, and evaluation to produce technologies that strengthen the U.S. response to current and projected threats to national security worldwide posed by the proliferation of weapons of mass destruction (WMD) or the diversion of strategic nuclear materials. NA-22 has sponsored a multiyear effort at ORNL to develop a prototype miniature mass spectrometer that will provide a marked increase in the ability to detect chemical species with high sensitivity and selectivity in the field, for use in both overt and covert monitoring. The objective of this program is to provide fieldable equipment for detection and characterization of chemical signatures released in the production, storage, or testing of nuclear weapons and related materials. A specific goal is to develop a microscale device that can generate mass spectra for analysis of gas-phase effluents. Initial target analytes include rare gases for isotopic analysis, gases evolved during fuel reprocessing operations such as NO_x, and volatile organic compounds. This project addresses one of the five principal nonproliferation signatures and several of the ten secondary signatures.

Mass spectrometers are usually considered to be laboratory instruments because of their size and weight and because of the vacuum system requirements. However, we have shown in this project that ion trap technology can be used to perform mass spectrometry in traps of submillimeter dimension. In scaling down the trap dimensions, other parameters (e.g., vacuum pumping requirements, operating voltages and frequency, and overall system size and weight) all become more favorable, making possible a fieldable hand-portable ion trap mass spectrometer. The device could also be used as a standalone monitor at a fixed location or as part of the payload of an unmanned aerial vehicle (UAV) for over-the-horizon effluent surveys. A capability for particulate sample analysis could be added if desired.

We have demonstrated several properties of miniature ion traps that may extrapolate to even smaller traps. Ion traps of 1-mm diameter were found to operate at lower voltage, higher frequency, and higher buffer gas pressure than their 2-cm-diam laboratory cousins. All of these conditions facilitate miniaturization. Ion storage capacity scales as the trap radius, so a two-dimensional array of traps operating in parallel could store more ions than a single trap of the same radius. To explore the possibility of generating mass spectra with a micro ion trap, we have set up a flexible laboratory system that can use various ionization sources, trap electrodes, and detectors, supporting evaluation of the individual components of a miniature system. We have assembled a battery-powered fieldable prototype instrument based on a commercial vacuum system using a 1-mm ion trap. The spectra are displayed on a personal digital assistant (PDA) platform for ease of use in the field. The prototype miniature mass spectrometer was demonstrated on September 23, 2004; it detected the presence of xenon present in a helium buffer gas with reproducible spectra on the PDA.

Rating: Outstanding.

1.5 SPALLATION NEUTRON SOURCE

The SNS is a next-generation short-pulse spallation neutron source that will be significantly more powerful than the best spallation neutron sources currently in existence. The nation's largest civilian science project, the SNS is being constructed by a team of six national laboratories. ORNL leads the project team. In FY 2004, the SNS project met or exceeded all schedule, cost, and technical requirements. The SNS is currently ~87% complete and remains on track to deliver a facility that meets approved project requirements by the scheduled completion date of June 2006.

1.5.1 Schedule Performance

Score: 4

Rating: Outstanding

Schedule performance on SNS milestones is presented in Table I.4, which shows that all milestones were completed ahead of scheduled completion dates.

Table I.4. Schedule Performance on SNS Milestones

Milestone	Scheduled completion	Actual completion	Rating	Points
Complete DTL Tank 1 Commissioning	10/31/2003	10/30/2003	Outstanding	4
Submit Revision to Safety Analysis of the Target Facility	12/31/2003	12/23/2003	Outstanding	4
Lower the Core Vessel in Place	12/31/2003	10/09/2003	Outstanding	4
Start Instrument Equipment Installation	03/30/2004	03/13/2004	Outstanding	4
Achieve Beam Transport through DTL Tanks 1–3	05/31/2004	04/23/2004	Outstanding	4
Start Target Hot Cell Equipment Installation	06/30/2004	04/08/2004	Outstanding	4
Complete Move out of 701 Scarboro Building	07/31/2004	06/30/2004	Outstanding	4
Achieve Beam Transport through CCL	09/30/2004	09/18/2004	Outstanding	4
Complete ETC for FY 2005 and 2006 Installation and Commissioning	09/30/2004	09/28/2004	Outstanding	4
Average	Outstanding			4

1.5.2 Budget Performance

Score: 3

Rating: Excellent

The contingency level based on the Estimate at Completion (EAC) as of the end of September is >\$18M. Although contingency has decreased, the level of undistributed budget has increased.

1.5.3 Technical and Managerial Performance and Continued Program Excellence

Score: 3.75

Rating: Outstanding

With ~87% of the project completed at the end of FY 2004, the SNS project continued to make outstanding progress on facility construction and technical components' installation and commissioning. In addition, design performance as observed through testing and commissioning results continues to exceed requirements.

Construction work at the site is being executed safely and is tracking to plan. In more than 3.1 million total construction hours, there was one lost work day and no environmental concerns. A key milestone on the project's critical path (hot cell readiness to receive technical components) was achieved. The Central Laboratory and Office (CLO) Building was partially completed, sufficient for SNS personnel to move from offsite leased space into the building, as planned.

Substantial progress was realized during this very technically challenging year in the installation and commissioning of technical components. Accelerator systems completed the following work essential for project success:

- installation of HVCMs, klystrons, DTLs and CCLs to support on-time commissioning and testing,
- commissioning of all DTL segments and CCL segments 1–3,
- commissioning the cryoplant, and
- initial installation and conditioning of cryomodules, with a very successful test of a cryomodule in the tunnel.

Major accomplishments in experimental systems included:

- on-time installation of the first major instrument component, the backscattering vacuum tank, and
- on-time start of installation of target/hot cell equipment (critical path) with considerable progress since then.

The project team successfully met some difficult challenges. The execution of the DTL recovery plan allowed on-time deliveries to support installation and commissioning. Two independent reviews focused on cryomodule production and helped to improve cavity production efficiency and ensure timely delivery. A series of technical issues were resolved during cryoplant installation and commissioning. Efforts to resolve challenges in a timely and cost-effective manner will continue in FY 2005 (e.g., target building construction and installation activities). Partner laboratory transition continued smoothly, with the third laboratory hand-off (LANL) achieved as planned in April 2004.

Based on a recommendation from the May 2004 DOE-SC review, an Integrated Installation Plan was prepared and reviewed/accepted by an independent team. This plan will be closely monitored and detailed plans adjusted as needed to ensure success.

During May 2004, the Earned Value Management System (EVMS) Review by OECM was completed with very impressive results — no corrective actions, three suggested improvements and three best

practices. The purpose of the review was to ensure that the management systems met the appropriate standards and provide the right information to management to exercise control. This was clearly validated during the review. SNS was the second DOE activity reviewed and the first major project to achieve this certification.

Cost control and minimizing contingency usage continues to be a major area of management emphasis. While remaining contingency is tight, perhaps the biggest remaining challenge is to sustain the project's schedule given the annual funding profile. BA usage was monitored closely throughout FY 2004 and was managed such that no drastic/damaging actions were required. Actions taken included (1) withholding ~15% of funding through midyear and then selectively increasing (e.g., Thomas Jefferson National Accelerator Laboratory) or limiting (e.g., BNL and LANL) funding to ensure schedule critical activities were adequately funded, (2) working closely with the ORNL finance organization to manage cash flow, (3) reducing overtime, materials and supplies, and travel, and (4) deferring some non-schedule-critical procurements. Budget Authorization (BA) planning for FY 2005 and dialog with the program office are currently under way. Cost and schedule plans will be adjusted, as required, to conform to the approved budget profile, and real-time BA management will continue to be exercised.

Another key challenge for the coming year is balancing our focus on successfully completing the project with the transitioning to operations. Initial steps in transitioning project and facilities management to operations were accomplished this year with the merging of the Conventional Facilities Division and the Project Office. Additionally, detailed planning for assuming site management from the AE/CM was begun.

1.6 PROGRESS TOWARD NEW SCIENCE CAPABILITY

Performance Measure 1.6 supports the S&T critical outcome by driving the Laboratory's ability to attract, develop, and promote new science capabilities. Section 1.6.1 describes ORNL's performance against the indicators for this performance measure.

1.6.1 New Research Initiative Composite

Score: 4.0

Rating: Outstanding

Table I.5 provides a summary of ORNL's performance in the new research initiative composite.

Milestone 1: By 6 p.m. on March 30, 2004, ORNL had rederived 51 lines of mice in the new Laboratory for Comparative and Functional Genomics, exceeding the goal of 35 lines. This was a critical step in reconstituting ORNL's extraordinary mouse colony, restarting the mammalian genetics research program, and attracting new research collaborators and sponsors. Reconstitution at this scale had never been performed at a research facility; it was conducted to ensure that the mice are free of specific pathogens that would prevent the sharing of these resources with other researchers.

Milestone 2: Four world-class instruments have been installed at the HFIR: the Residual Stress Diffractometer at HB-2B, the Wide-Angle Neutron Diffractometer (WAND) at HB-2C, and the Reflectometer and SNS Detector Test Station at HB-2D. These instruments increase the capability of HFIR in residual stress, structure, and diffuse scattering studies by factors of 3-10, providing world-class capabilities for materials research currently not available in the U.S



Wide-Angle Neutron Diffractometer

Milestone 3: Staff from ORNL's High Temperature Materials Laboratory tested the new Aberration-Corrected Electron Microscope (ACEM) at the JEOL factory in Japan in February 2004. The microscope satisfactorily met expectations. A diffraction pattern of a single crystal of silicon demonstrated information transfer at the subangstrom level (the 440 reflection of Si at 0.96 Å). The ACEM was then shipped to ORNL in May 2004 and installed in the new Advanced Microscopy Laboratory. Electron beams have been successfully produced and run through the column and its energy filter onto the assorted cameras and detectors. Images have been acquired in bright-field transmission electron microscopy (TEM) mode, and energy-loss electron spectra have been acquired in TEM mode. In scanning transmission (STEM) mode, bright- and dark-field images have been acquired on their respective detectors. The aberration corrector has been demonstrated to function properly in STEM mode, with a demonstration of an improvement in the diameter of the incident electron beam from a nominal 1.4 Å down to the subangstrom range. It is expected that the ACEM will achieve ultimate-resolution images of actual project materials when ambient environmental and power issues in the new laboratory have been successfully resolved.



Aberration-Corrected Electron Microscope

Milestone 4: The Cray X1 system was used to run several scientific applications from the selected target areas of climate modeling, fusion simulation, materials sciences, and computational biology. One of these was the Parallel Ocean Program (POP), which executes more than 50% faster than on the Earth Simulator system in Japan; another was the EX superconductivity code, which is being used to solve a previously unsolvable problem in materials science relating to the exact mechanism of superconductivity. Both were completed before May 30, 2004.

Milestone 5: The National Science Foundation (NSF) TeraGrid is a multiyear effort to build a national cyber infrastructure, which will connect major computer centers around the country to allow researchers to seamlessly share data, computer resources, and visualization capabilities. The ORNL-led addition to the TeraGrid, called the Southeastern TeraGrid Extension for Neutron Science (SETENS), will allow scientists to use the massive computing and data storage resources on the TeraGrid to make rapidly detailed analyses and visualizations of data from neutron scattering experiments. The Oak Ridge TeraGrid site was connected to the new Atlanta TeraGrid hub on September 30, 2004.



TeraGrid Network

Table I.5. Milestones and performance for New Research Initiative Indicator

Milestone	Date completed		Rating	Points
	Scheduled	Actual		
1. Rederive specific-pathogen-free (SPF) breeding stocks for the mouse colony in the Laboratory for Comparative and Functional Genomics. Specifically, 35 strains of mice used in research will be brought back from frozen embryos to live, SPF mice to be used in research.	3/31/2004	3/30/2004	Outstanding	4
2. Complete installation of four additional thermal neutron scattering spectrometers. These instruments increase the capability of HFIR in residual stress, structure, and diffuse scattering studies by factors of 3-10, providing world-class capabilities for materials research currently not available in the U.S	9/30/2004	9/16/2004	Outstanding	4
3. Complete delivery and installation of the ultrahigh-resolution aberration-corrected electron microscope and demonstrate full operation of critical imaging systems.	9/30/2004	9/16/2004	Outstanding	4
4. Perform “proof-of-principle” science computations on the Cray X1 in at least two science areas.	6/30/2004	5/30/2004	Outstanding	4
5. Connect the ORNL Center for Computational Sciences to the national TeraGrid project.	9/30/2004	9/30/2004	Outstanding	4
Average			Outstanding	4

2. EXCELLENCE IN OPERATIONS AND ES&H

Critical Outcome: We will sustain and improve ORNL’s ability to serve the needs of DOE and the nation through responsible stewardship.

In discussions about ORNL’s operations and ES&H performance for FY 2004, DOE’s Oak Ridge Operations Office (DOE-ORO) identified three areas of special concern: purchasing, property management, and human resources (HR). Although no specific metrics were established for these areas, ORNL took aggressive action to address each one, as reported here. We believe that we delivered outstanding performance in addressing DOE-ORO concerns in these areas.

Purchasing

The ORNL Acquisition Management System (AMS) team provided solid leadership in creating and maintaining an outstanding purchasing system:

- ORNL staff now view the purchasing system as a help rather than a hindrance. AMS customer surveys showed outstanding results, with approval scores of at least 95%.
- Our DOE customers noted the cultural improvement in procurement and provided several positive comments on improvements in the quality of contract operations, resulting in part from our use of new standard contract formats and our active engagement in several DOE Headquarters contract initiatives.
- The cost of acquiring items/services at ORNL is 1.4 cents per dollar, 50% lower than the goal (DOE CAPS average) of less than 2.1 cents.
- Our performance improvement efforts yielded cost savings/avoidances of more than \$2.7 million in FY 2004, demonstrating a high level of operational effectiveness.
- We exceeded our FY 2004 small business goals in all categories by 10% to 15%. The strong relationship between the ORNL Contracts Division and the Small Business Program Office was a key contributor to this achievement.

- We delivered outstanding performance in timely payment to vendors (87.2% of payments were made on time) and in delivering acquired materials to our customers (our door-to-door average is less than 24 hours).

To improve ORNL's supply chain management, the AMS team reviewed and analyzed all processes, associated benchmarks, and external assessment results. The team also completed the following tasks:

- A study of the feasibility of contractor management of bench stock items.
- Implementation of the Automated Clearing House (ACH) payment process.
- Incorporation of two standard solicitation and contract formats, replacing more than 20 previous variants.
- Relocation of the excess property sales operation to an offsite location.
- Self-assessment and gap analysis of ORNL procurement operating processes in preparation for a DOE Procurement Evaluation and Re-engineering Team (PERT) Peer Review in FY 2005.
- Support to the ORNL–Princeton Plasma Physics Laboratory (PPPL) team that prepared the winning proposal for the U.S. ITER Project Office. The team drew heavily on ORNL's AMS in preparing this proposal.

ORNL also participates in a procurement working group with Battelle Science and Technology International, Brookhaven National Laboratory (BNL), and Pacific Northwest National Laboratory (PNNL). The group's goal is to integrate procurement services at these institutions into a single, synergistic system and improve effectiveness and efficiency by avoiding cost, minimizing risk, reducing procurement cycle time, making more efficient use of resources, attaining programmatic consistency, incorporating technical/quality requirements, and facilitating internal customer satisfaction. The working group is developing standardized administrative and auditing procedures, supplier lead auditor training and qualification/certification, and the Battelle Integrated Supplier Information System (ISIS). The process for qualification/certification of supplier lead auditors will produce a cadre of technically competent auditors who will be available to conduct supplier audits at the participating institutions. The ISIS database, which was deployed this fiscal year, serves as a single repository for supplier evaluation information. ISIS was designed for expansion to capture additional supplier information such as performance results. The full program is targeted for completion in January 2005.

Property Management

Increased attention to property management issues during FY 2004 led to several improvements in the existing system. Laboratory management attention to this issue was heightened; all accountable property losses are now reviewed annually by ORNL's Level 1 managers. Property custodian responsibilities were reviewed with all ORNL staff via required reading material distributed by the Laboratory's chief financial officer. A systematic approach was also applied to property custodian training. Processes for identifying, tagging, inventorying, and excessing property and material were improved. Leasing of an off-site warehouse location for excessing and sales has improved customer access, with the added benefit of improved safety and working conditions compared to the former on-site location. Revenues from property sales increased during the year, as did donations to schools and nonprofit organizations. All DOE Balanced Scorecard measures were met or exceeded.

Human Resources

In FY 2004, the ORNL HR Directorate began implementing the HR Strategic Plan (prepared to meet an FY 2003 PEP objective) and made significant progress against its objectives and goals.

Benefits/employee Welfare

ORNL implemented several new approaches designed to control the cost of benefits.

- A new health care plan was introduced to expand employee choice while achieving cost savings. Indications are that medical plan changes made in 2004 limited the medical inflationary trend to less than 10% for the year versus a projected increase of 15%; this should result in savings of \$1.6 million.
- An Integrated Disability Management Program was implemented to support “return to work” efforts, improve case management, and provide for better administrative handling of disability and family medical leave issues.
- The short-term disability plan was changed to better control utilization while providing a competitive benefit.
- A Disease Management Program was introduced in July 2004. This program is expected to have a return on investment of 3:1 in lowering the costs related to chronic conditions and diseases.
- A Wellness Coordinator was hired to manage the ORNL Wellness Program and expand initiatives to help employees maintain a healthy lifestyle, thereby reducing health care cost.

Compensation Programs

ORNL salaries, salary band midpoints, and reference pay zones are compared annually to assess their competitiveness. Approved salary survey data are used to objectively measure market relationships for eight salary structures.

We continue to make progress toward reducing deficits in the market position. Market equity adjustment funds were allocated during 2004 to help address the largest deficits and additional adjustment funds have been included in ORNL’s 2005 Compensation Increase Program request to continue closing this gap.

Staffing and Recruiting

- Process improvements to enhance external recruiting were implemented with additional improvements planned for FY2005.
- A comprehensive workforce plan and forecast was completed in late FY 2004 that defines the laboratory’s workforce needs for the next five years. An integrated and sustained recruiting program with needed resources is being implemented in FY 2005 in response to this forecast.

HR Service Delivery

Extensive input from HR stakeholders and customers was gathered in 2004. A new set of service delivery standards was developed, leading HR to reexamine its structure, roles, and services. Several actions have been or will be taken to implement this new model.

- Realigning HR priorities, organizational structure and roles to meet Laboratory and customer needs. In particular, the role of the HR Managers will be reviewed with the objective to become more strategic in helping develop and implement their assigned organization’s strategic human resources agenda.
- Identifying systems and processes in HR needing improvement.
- Increasing focus on addressing employee concerns and staff engagement with the objective to improve retention and enhance employee productivity. To do this, HR is examining proven employee assessment tools to assess staff engagement and is developing follow-on plans for organizational improvement.
- Building additional HR capabilities, particularly for recruiting and HR management.

International Services

Enhancing the services provided to our increasingly diverse and international staff and visitors is essential to assure a positive employment experience for staff, as well as facilitate positive visits for our many lab users, conference attendees and guests. An international services program was developed for FY 2005 implementation.

Labor Relations

ORNL's labor relations strategy is an interest-based approach to achieve goals specifically communicated to the Atomic Trades and Labor Council (ATLC). In FY 2004, negotiations resulted in a five-year agreement.

HR Performance Assessment

The FY 2005 HR Business Plan, modeled on the HR Strategic Plan, set goals and objectives for the upcoming year with a wide range of metrics to assess its success and effectiveness in meeting these goals and objectives. The measures will focus on not only results, but also critical aspects of process performance.

2.1 FACILITIES MODERNIZATION

2.1.1 Facilities Revitalization Program Composite

Score: 3.75

Rating: Outstanding

Table I.6 provides a summary of ORNL's performance in the facilities revitalization program composite.

Table I.6. Components of the Facilities Revitalization Program Composite

Milestone	Rating	Score
Substantial completion of construction – AML	Outstanding	4
Substantial completion of construction – RSC	Excellent	3
Substantial completion of construction –7625 High Bay	Outstanding	4
Complete readiness to support request of earned value system validation	Outstanding	4
Average score	Outstanding	3.75

Complete Construction of AML

Substantial completion of the Advanced Microscopy Laboratory (AML) was achieved on February 25, 2004, meeting the criteria for an "Outstanding" rating. The AML has a number of unique features, including epoxy-coated rebar to reduce electromagnetic currents, "house-in-house" design to isolate the research instruments, low-flow ductwork and mechanical equipment to reduce vibration and noise, and physical separation of the mechanical area from the research area. Substantial completion was achieved seven months after the start of construction in August 2003, despite the challenges presented by the unique design.

Complete Construction of the RSC

Substantial completion of the Research Support Center (RSC) was achieved on September 30, 2004, meeting the criteria for an “Excellent” rating. Construction of the RSC started in July 2003. Several factors contributed to missing the date for an “Outstanding” rating: adverse weather occurred during critical outdoor activities. The vendor for exterior window glass went out of business during the project delaying the delivery of some of this material. Brick installation was delayed by the poor performance of a lower-tier subcontractor.

Complete Construction of the 7625 High Bay

Substantial completion of the Multipurpose High Bay Facility (Building 7625) was achieved on August 23, 2004. Substantial completion was expected by July 31, 2004, but 12 days were lost due to the need to address site conditions found during excavation, and three more days were lost due to the Presidential visit in July. A plan to make up the lost time by allowing the subcontractor to work overtime was developed, but it was tabled at the direction of the DOE Project Director. Because a joint evaluation that the milestone would have been achievable had the plan been implemented, we have judged our performance to be “Outstanding.”

Complete Readiness to Support Request of Earned Value System Validation

Active work by the Facilities Development Division (FDD) to improve project management and control processes, procedures, and systems has led to implementation of a comprehensive project management system capable of meeting the Earned Value Management Systems (EVMS) Criteria required by the ANSI/EIA Standard 748-1998, on a schedule that supports a rating of “Outstanding” for this milestone. Certification to this standard is currently required by DOE M 413.3-1 on all projects exceeding \$20 million. In addition, the FDD Management System (FDDMS) has been established to allow for a graded implementation. As a result, FDDMS can be used for all projects, not just large line-item projects.

FDDMS implementation proceeded as follows:

- Project and process flowcharts for all key processes were developed.
- A gap analysis was performed by cross-walking the existing project management processes and procedures against the EVMS Criteria described in the ANSI/EIA Standard 748-98 to ensure that the criteria were fully incorporated into FDDMS.
- An FDD Business Process Plan was developed to provide an overview of the system requirements and implementation. This document was issued on June 22, 2004, and is available on the FDD Web page.
- Implementing procedures for all key earned value (EV) processes were issued on June 24, 2004. These procedures meet all of the requirements of ANSI/EIA Standard 748-98 but also allow flexibility for a graded approach on smaller projects for which full EV compliance is not required. Training on the new procedures is ongoing and will continue as necessary.
- Training on the system and the principles behind it was conducted for all key FDD personnel and selected persons from other divisions (Procurement, FMO, ES&H) that directly support FDD projects. Three classes were developed:
 - Project Management Basics (PM 101), January 2004,
 - Risk Planning, Estimating and FDD Documentation (PM 102), April 2004, and
 - Implementation of EV in FDD (PM 103), June 2004.

- An independent review of FDDMS was conducted by Performance Management Associates, Inc. to provide assurance that the system was ready for implementation and certification. The review included a site visit, completed on June 9, 2004, to review documentation and interview selected FDD personnel on implementation of EV principles on specific projects. The assessment validated that FDDMS is ready to support the DCMA audit.

FDDMS is currently being used for all FDD projects on a graded approach. The proposed project for certification audit is the Energy Research and Engineering Laboratory (EREL), a recently initiated line-item project with a cost of \$20 million.

As with any major system implementation, refinement to the system will be necessary, but we are now confident that the system is complete and adequate for certification review.

2.1.2 Prepare Facilities to Transfer to Non-SC Programs

Score: 4

Rating: Outstanding

A total of 108,126 square feet of space was deactivated and/or demolished in FY 2004, exceeding the 100,000 square feet needed for an “Outstanding” rating. Actions were documented in the Facility Information Management System (FIMS) database. In addition, all research staff located in Building 9204-3 at the Y-12 National Security Complex were moved to the main ORNL campus in FY 2004. The building and the calutron infrastructure will remain in standby as ordered by the Inspector General. This facility contributes an additional 255,656 square feet of vacated space to the overall modernization goal of 1.8 million square feet.

2.1.3 Personnel and Equipment Moves

Score: 4

Rating: Outstanding

Overall performance of moves of both laboratories and personnel exceeded plans during FY 2004. Move requirements are dynamic in nature, responding to the changing needs of research and operations, and adjustments were made to the move plan as needed.

The Facility Revitalization Project (FRP) Consolidation and Campus Integration Plan for FY 2004 listed 24 moves. Moves of two laboratories—the Analog/Digital Systems Laboratory in Engineering Science and Technology Division and the Membrane Technology Laboratory in Metals and Ceramics Division—were deferred by operational considerations. Five laboratories that were not in the original plan were moved during the year. Thus, 27 laboratories were moved in FY 2004, yielding completion of 112.5% of planned laboratory moves.

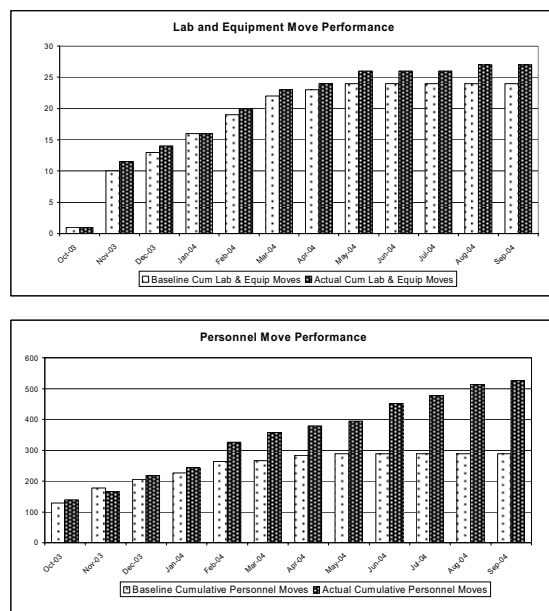


Figure I.3. FY 2004 planned and actual moves.

The number of personnel moves planned for FY 2004 was 289; as changing requirements necessitated the relocation of personnel, 237 additional moves were completed, yielding a total of 526 actual moves completed (182% of plan).

2.1.4 Maintenance Metric Composite

Score: 4

Rating: Outstanding

ORNL's achievement of an outstanding rating on this measure can be attributed to efforts by the Laboratory's maintenance organizations to more accurately capture and record maintenance cost. The "annualized" FY 2004 Maintenance Investment Index (MII) is 2.5% (RPAM measure) and 3.2% utilizing the PEP measure for active buildings only. The maintenance cost per gross square foot is \$6.25 (baseline measure only).

As of October 21, 2004, FIMS lists 199 active buildings owned by DOE's Office of Science with a gross square footage (GSF) of 2,922,822. The replacement cost value (RCV) of these assets is \$573,529,858 with approximately \$18,277,019 spent on maintenance during FY 2004.

2.2 OPERATIONAL DISCIPLINE

2.2.1 Safety and Health Composite

Score: 3.00

Rating: Excellent

The Safety and Health Composite score is "Excellent." As indicated in Table I.7 and discussed below, performance on three components of the composite (TRC Rate, Subcontractor LTC Rate, and the Nuclear Safety Violation Index) was marginal.

Table I.7. Components of the Safety and Health Composite

	Indicator	Rating	Points
SH-1	TRC Rate	Marginal	7
SH-2	DART Rate	Outstanding	5
SH-3	Exposure to Toxic and Physical Hazards	Outstanding	5
SH-4	Subcontractor LTC Rate	Marginal	2
NS-1	Nuclear Safety Violation Index	Marginal	19
RP-1	Worker Radiation Dose	Outstanding	15
RP-2	Radiological Operations Index	Excellent	14
FP-1	IT&M Services	Outstanding	5
SB-1	Natural Phenomena Hazards	Outstanding	15
Composite Score:		Excellent	87

The total recordable case (TRC) rate (indicator SH-1) measures the rate of work-related injuries and illnesses as described by the OSHA recordkeeping criteria. It is based on the total number of recordable injuries per 200,000 hours worked. For FY 2004, the final injury rate of 2.0 represents a 26% improvement compared to FY 2003, but, because the FY 2004 PEP target was set far more aggressively, the achieved rate is considered "Marginal." Soft tissue injuries were the leading type of work related injury/illness and ORNL will continue to focus improvements in this area.

The Laboratory demonstrated significant improvement in the days away, restricted, or transferred (DART) rate (indicator SH-2) during FY 2004. The final rate of 0.5 is well below the FY 2003 result of

0.8 and exceeds the criteria for an Outstanding rating. This notable reduction in the severity of injuries can be attributed to the increased focus on safety by UT-Battelle management, aggressive case management by division directors, and the overall reduction in recordable injuries.

Exposures to toxic and hazardous materials (indicator SH-3) were maintained below identified occupational exposure limits by use of engineering, administrative, and personal protective controls. Biological exposures were also maintained below assigned indices for monitored materials. This resulted in an Outstanding rating.

Subcontractors experienced four lost time away cases (LTCs) in FY 2004. With the low number of work hours, this resulted in a rating of 0.62 (Marginal) for indicator SH-4.

The Nuclear Safety Violation Index (NSVI, indicator NS-1) reached a value of five, which represents a rating of Marginal, as a result of the P-AAA event at HFIR, for which two points were assigned; the P-AAA event at Building 2026, for which two points were assigned, and the Technical Safety Requirements (TSR) violation at the Radiochemical Engineering Development Center, for which one point was assigned.

The average measurable dose to DOE workers is calculated by dividing the total effective dose equivalent by the number of individuals with measurable dose. The worker radiation dose for this reporting year (indicator RP-1) is 82 mrem, which meets the criteria for a rating of Outstanding.

The Radiological Operations Index (ROI, indicator RP-2) is calculated on an annual basis from July 1 through June 30. For this year, ROI = 6.1, meeting the criteria for an Excellent rating. Various radiation-related occurrences accounted for 5.1 points; the additional point was incurred when a worker exceeded an ALARA goal by more than 5%.

During FY 2004, 100% of the scheduled IT&M services (indicator FP-1) were performed, yielding an Outstanding rating.

The scheduled update of facility-specific natural phenomena hazard analyses (indicator SB-1) was completed during the first quarter of the fiscal year, more than 30 days in advance of the requested date, meeting the criteria for an Outstanding rating.

2.2.2 Environmental Composite

Score: 4

Rating: Outstanding

ORNL delivered outstanding environmental performance in FY 2004, as summarized in Table I.8. A key element was the successful completion of an ISO 14001 registration audit in August 2004. ORNL had no reportable releases to the environment in FY 2004, and only one significant finding resulted from inspections conducted by regulators when TDEC issued a Notice of Violation for several radiologically contaminated legacy waste drums. Compliance inspections were conducted in two regulatory areas: the Clean Air Act (CAA) and the Resource Conservation and Recovery Act (RCRA). Positive observations were made by the regulators in all compliance areas. In addition to the ISO 14001 registration audit, a certification audit was conducted by the Nevada Test Site (NTS) to certify UT-Battelle as a waste generator authorized to ship waste to the NTS for disposal. Four reportable permit nonconformances were attributed to UT-Battelle activities.

Table I.8. Environmental performance

Indicator	FY 2004 Target/Points
<u>Reportable releases to the environment: (0)</u> Includes CERCLA Reportable Quantity exceedances and releases of petroleum products attributable to UT-Battelle activities that require notifications of the regulators.	<i>Outstanding: 0 releases</i> 5 Excellent: 1 release 4 Good: 2 releases 3 Marginal: 3 releases or more 2
<u>Significant findings from inspections by regulatory agencies: (1)</u> Includes UT-Battelle's accepted (or validated) findings of regulatory noncompliance that require a formal response, corrective action, or result in an enforcement action. Does not include recommendations, best management practices, etc., or non-regulatory findings issued by TDEC-EOE-O.	Outstanding: 0 findings 5 <i>Excellent: 1 finding</i> 4 Good: 2 findings 3 Marginal: 3 findings 2
<u>Reportable permit non-compliances: (4)</u> Includes UT-Battelle NPDES non-compliances and reportable air permit non-compliances, reportable Clean Water Act and Clean Air Act non-conformances, including limit exceedances. A single "event" that results in multiple permit exceedances or non-conformances will be counted as one noncompliance for this indicator. Does not include TSCA unauthorized use notifications as described in the ORO TSCA FFCA.	Outstanding: 0 non-compliances 5 <i>Excellent: 1-4 non-compliances</i> 4 Good: 5-8 non-compliances 3 Marginal: 9-10 non-compliances 2
<u>Implementation of the EMS Requirements of DOE Order 450.1</u> Obtained independent verification.	<i>Outstanding</i> 5 Excellent 4 Good 3 Marginal 2
Total Composite:	Outstanding 18

The individual and composite ratings for this performance measure reflect both organizational effectiveness and the maturity of ORNL's environmental compliance and waste management programs. Performance by the operating and research organizations in implementing these programs was sustained another year. Challenges included reduced Environmental Protection and Waste Services Division (EP&WSD) oversight of UT-Battelle activities, as well as diversion of key EP&WSD core resources to the development of the EMS and major legacy material removal initiatives. This sustained level of performance is attributed to the line organization's increased ownership and use of deployed resources such as Environmental Compliance Representatives (ECRs), Waste Services Representative (WSRs), and other technical support personnel, as well as the strengthening of EMS subject areas and procedures.

2.2.3 Performance Based Management Composite Rating

Score: 3.01

Rating: Excellent

During FY 2004, the Laboratory assessed the performance assessment programs in six divisions and three directorates. While a new set of organizations was evaluated this fiscal year, the scores were higher than those for last year's evaluations. Process improvement has been found to be more mature and the results continue to provide insights that will assist the performance assessment process as the mechanism used to drive continuing improvement.

The composite FY 2004 rating of 3.01 (out of a possible four points) resulting from the reviews by ORNL's Oversight and Assessment Services (O&AS) organization is encouraging. This is the highest rating attained in the four years in which these evaluations have been conducted, and it compares favorably with the rating of 2.9 in FY 2003. The range of scores for this year (2.2 to 3.6) indicates that there is still opportunity for improvement in developing a more consistent understanding and implementation of PBMS processes and tools.

General strengths of the performance assessment process are the demonstrated ownership and effectiveness of line management with regard to all aspects of performance assessment. This was evident at all levels of management. General areas that need improvement are the prioritization of the assessment activities and the application of the assessment results to drive improvement. Additional details are provided in Tables I.9–I.11 and Part V of this report.

Table I.9. Directorate performance for Performance Based Management Composite

Directorate (report number)	Approach (20%)	Deployment (0%)	Process Improvement (80%)	Score
Audit and Assessment Directorate (IO-2004-07)	3.5	3.5	3.6	3.6
ESH&Q Directorate (IO-2004-17)	3.4	3.4	2.6	2.9
Physical Sciences Directorate (IO-2004-22)	3.4	3.1	2.7	2.9
Directorate Average	3.13			

Table I.10. Division performance for Performance Based Management Composite

Division (report number)	Approach (10%)	Deployment (10%)	Process Improvement (80%)	Score
Chemical Sciences Division (IO-2004-09)	3.3	2.6	3.4	3.3
Condensed Matter Sciences Division (IO-2004-15)	2.0	2.1	2.2	2.2
Craft Resources Division (IO-2004-23)	2.7	3.1	2.9	2.9
Facilities Development Division (IO-2004-19)	2.5	3.1	2.8	2.8
Nonreactor Nuclear Facilities Division (IO-2004-24)	3.3	3.5	3.4	3.4
Nuclear Sciences and Technology Division (IO-2004-06)	3.3	3.0	3.3	3.3
Division Average	2.98			

Table I.11. Overall performance for Performance Based Management Composite

Organization	Average Score	Weighting	Value
Directorate	3.13	20%	0.63
Division	2.98	80%	2.38
Composite Score			3.01

2.2.4 User Facility Operability/Reliability Composite

Score: 3.11

Rating: Excellent

Table I.12 provides a summary of ORNL's performance in the operation of user facilities.

Aging equipment and legacy issues at the High Flux Isotope Reactor (HFIR) reduced the availability of this important user facility. HFIR availability during the year was 35%; more than 80% of the delays in planned reactor startups resulted from equipment aging or legacy issues. The predictability was 68%.

Calculated availability at the Holifield Radioactive Ion Beam Facility (HRIBF) was 62%, and predictability was 92%. Weekends are considered in the availability calculation, even though the present operating budget does not allow operation on most weekends.

The High Temperature Materials Laboratory (HTML) Users Program assists industrial, academic, and governmental R&D. The HTML User Program had a very large number of new project proposals, including proposals from 19 new, first-time institutions. The HTML User Program received \$4.6M in operating funds this year; with 87 projects to date, the projects/funding ratio is 19.

Isotope production activities achieved outstanding performance.

- Customer specifications were met on 276 of 277 orders (99.6%, versus a goal of 98%).
- Shipment of radioisotopes was on time for 119 of 122 orders (97.5%, versus a goal of 95%).
- Shipment of stable isotopes was on time for all 155 orders (100%, versus a goal of 97%). Late shipments in January, February, and April were delayed at the request of the customer and are not included in these results.

The Center for Computational Sciences (CCS) production systems delivered 65,147,457 MPP hours, exceeding the goal. Evaluation systems delivered an additional 38,163,184 MPP hours, for a total on all systems of 103,310,640 MPP hours.

Table I.12 User facility performance

Indicator	Rating	Score
High Flux Isotope Reactor		
Availability	Good	2
Predictability	Good	2
Average		2
Holifield Radioactive Ion Beam Facility		
Availability	Outstanding	4
Predictability	Outstanding	4
Average		4
High Temperature Materials Laboratory		
New Users	Outstanding	4
Number of projects per dollar of available funding	Outstanding	4
Average		4
Isotope production		
Packages meeting customer specifications	Outstanding	4
On-time delivery of radioactive isotopes	Outstanding	4
On-time delivery of stable isotopes	Outstanding	4
Average		4
Center for Computational Sciences computing capacity	Outstanding	4
Composite score:	Excellent	3.11

2.2.5 Integrated Safety Management Maturity Evaluation

Score: 4

Rating: Outstanding

The completion of all 42 identified ISM evaluations on schedule meets the criteria for an Excellent rating, without considering other factors. Given the notable positive assessment of the Laboratory's ISM program by the DOE HQ OA-40 team, we expect that DOE will determine that these evaluations have a significant impact, thereby meeting the criteria for an Outstanding rating.

2.3 MAXIMIZING RESEARCH EFFECTIVENESS

2.3.1 Core Composite Rate

Score: 4

Rating: Outstanding

The Core Composite Rate (CCR) for FY 2004 is 60.0% (lower than our original goal of 61.9%) which falls into the Outstanding range (less than or equal to 61.5%). FY 2004 indirect costs were less than originally planned. The indirect cost savings for the Voluntary Separation Program plus savings from other areas have been used to make investments in nuclear safety; these investments address legacy issues and are not included in the calculation of this measure. The recovery base for FY 2004 exceeded the original budget because of higher than expected growth in national security, nuclear energy, and Work for Others (primarily for the Department of Homeland Security, the Department of Defense, and the National Aeronautics and Space Administration).

2.3.2 Skilled and Diverse Work Force

Score: 0.85

Rating: Marginal

As indicated in Table I.13, this indicator has two components: demonstrating progress in addressing underutilizations by additions (hires, promotions, and transfers) of women and minorities at or above availability in two job categories, Officials and Managers (O&M) and Professionals, and demonstrating the use of targeted recruitment strategies and company policies that result in diverse applicant pools for external hires.

Table I.13. Skilled and Diverse Work Force

Indicator	Score	Weight	Value points	Rating
1. Underutilizations				
Officials and Managers		45%		
Women	0			Marginal
Minorities	0			Marginal
Professionals		45%		
Women	2			Good
Minorities	0			Marginal
Total			0.45	Marginal
2. Recruitment strategies	4	10%	0.40	Outstanding
Total		100%	0.85	Marginal

Indicator 1: Demonstrate progress in addressing underutilizations.

At the end of FY 2004, an upward trend was observed in three of the four categories of this indicator. This trend can be attributed to increased management accountability:

- When filling job vacancies, managers are being asked to address Laboratory-wide underutilizations, even if the hiring division does not have an underutilization in the groups for which they have openings.
- Senior managers are being provided with Laboratory-level applicant and hiring information (including the number of women and minorities in the applicant pools). This helps them focus their efforts on meeting laboratory goals and identify any problem areas.
- ORNL's Deputy Directors are expected to approve any new hires that do not support underutilization goals.

Despite the increased focus on this area in FY 2004, UT-Battelle fell short of its overall target for reducing "Underutilizations." For an Excellent rating, the target was to hire and promote at a rate $\geq 5\%$ over availability; for Outstanding rating, $\geq 7.5\%$ over availability. Through September, the "additions" against "availability" were as follows:

- O&M women: 20.3%, compared to availability of 25.2%
- O&M minorities: 7.8%, compared to availability of 12.2%
- Professional women: 19.3%, compared to availability of 15.3%
- Professional minorities: 12.2%, compared to availability of 16.0%

Table I.14 reflects these additions. (Note: Total opportunities for women and minorities are not the same because they are underutilized in different job groups.)

Table I.14. Additions of women and minorities in FY 2004		
	Officials and Managers	Professionals
Women		
Total opportunities	79 (21 new hires, 58 promotions)	114 (72 new hires, 42 promotions)
Number added	16 (2 new hires, 14 promotions)	22 (14 new hires, 8 promotions)
Minorities		
Total opportunities	90 (22 new hires, 68 promotions)	197 (131 new hires, 66 promotions)
Number added	7 (2 new hires, 5 promotions)	24 (17 new hires, 7 promotions)

Underutilizations at the beginning and end of FY 2004 are compared in Table I.15, which shows that underutilizations were reduced significantly (by 20.9%) during the year.

Table I.15. Representation and underutilizations of minorities and women

	As of October 1, 2003			As of September 30, 2004		
	Total	Minorities	Women	Total	Minorities	Women
O&M						
Representation	460	34 (7.4%)	75 (16.3%)	462	34 (7.4%)	79 (17.1%)
Underutilizations		22	41		22	38
Professionals						
Representation	2001	229 (11.4%)	452 (22.6%)	2015	238 (11.8%)	462 (22.9%)
Underutilizations		86	50		84	34
Total underutilizations		108	91		106	72

Challenges that we face include

- increasing the size of the applicant pools for the overall number of qualified candidates,
- increasing the number of women and minorities in the candidate pool, and
- institutionalizing an appreciation for and commitment to diversity.

We have developed the following strategies for success:

- The Workforce Planning and Development initiative on the Laboratory Agenda includes a specific recruitment focus for FY 2005, as well as employee development.
- Current succession planning efforts include addressing diversity as a key component.
- We are improving our methods of tracking and reporting applicant pool data.

Indicator 2: Demonstrating the use of targeted recruitment strategies and company policies that result in diverse applicant pools for external hires.

Score: 4

Rating: Outstanding

A number of successful recruiting activities during 2004 will increase the numbers and quality of diverse candidates in applicant pools:

- The second annual “Day of Science” drew 200 undergraduate students and 70 faculty members from Historically Black Colleges and Universities (HBCUs).
- A tour of ORNL was arranged for 37 African-American students attending the National Conference of Black Physics Students in Nashville.
- ORNL representatives participated in four minority-targeted career fairs.
- A representative of SNS presented a plenary talk at the 2004 Annual Conference of the National Society of Black Physicists and Black Physics Students, which was held as a joint conference with the Annual Meeting of the National Society of Hispanic Physicists.
- New relationships with Tennessee State University (an HBCU) led to the establishment of the first SNS Faculty and Student Team (FaST).
- A cooperative program was established with Tennessee Tech; the first co-op student is an electrical engineering major.
- ORNL supported the Top 50 Most Important Blacks in Science Award Ceremony, at which an ORNL researcher was recognized.



“Day of Science” Students Tour

We also took advantage of opportunities to advertise both for specific types of candidates and to promote ORNL as a premier employer through

- “Who’s Hiring at HBCUs,” a career guide that was distributed at 118 HBCU institutions;
- publication of *Diversity Careers in Engineering and Information Technology*;
- an advertisement in *Black Collegian* for an analog/digital engineer;
- an advertisement to the Society for Women Engineers (SWE) for an engineering science and technology position; and
- outreach through diversity Web sites and publications, including those of SWE and the National Society of Black Engineers.



To assist in building support within the Laboratory, the Laboratory Director asked the ORNL Committee for Women and the Asian Pacific American Committee to help with some diversity-related actions (e.g., submitting names for succession planning and identifying conferences/events that focus on women).

New Employment Advertising at ORNL

The ORNL Leadership Team reviewed the report of the Diversity Focus Group and took action to (1) establish specific diversity-related goals in each Level 1 manager’s performance objectives; (2) implement mechanisms to better coordinate diversity initiatives and sharing of best practices across ORNL; (3) track and review diversity performance in the monthly “Flash Report,” and (4) charter a team of senior managers and HR staff who outlined a workforce development strategy for ORNL.

2.4 LEGACY ISSUES

2.4.1 Liquid and Gaseous Waste System Modernization

Score: 4

Rating: Outstanding

ORNL’s performance on modernization of liquid and gaseous waste treatment systems is judged to be Outstanding. The Liquid and Gaseous Waste Treatment System Reengineering Project received \$520,000 of ORNL Operations Improvement Program (OIP) funds and \$600,000 of Health and Safety Initiative (HSI) funds to reduce vulnerabilities associated with liquid and gaseous waste. The project performed engineering analyses in support of the FY 2003 *ORNL Liquid and Gaseous Waste Treatment System Strategic Plan*, which identifies a series of expense planning and capital projects to build new liquid and gaseous waste treatment systems that are required to support the DOE-SC mission for the next 50 years. Engineering studies and cost estimates were performed for upgrade of the sanitary waste, gaseous waste, and low-level waste (LLW) systems. Preliminary proposals and justification of mission need documents were developed for once-through cooling water, sanitary, gaseous, and LLW waste upgrades, meeting the requirements outlined in the PEP. These developments support disconnecting DOE-SC facilities from the existing treatment facilities operated by DOE’s Office of Environmental Management (DOE-EM) by 2010 (i.e., the planned beginning of DOE-EM Bethel Valley remediation). They reduce ES&H risks, improve effluent quality, and reduce operating costs through pollution prevention, improved efficiency, and minimizing underground piping and long-term underground storage of liquid waste.

The following specific achievements were delivered in support of this indicator:

- The Preliminary Proposal for the Bethel Valley Process Waste Cooling Water Elimination was submitted to DOE on July 6, 2004 (well in advance of the PEP commitment of August 30, 2004). The total project cost is estimated to be \$3.1M of GPP funds. A request for \$0.5M of FY 2005 GPP funding has been submitted in the FY 2005 planning base letter to support the start of design and construction on initial high-priority buildings next fiscal year.
- A Project Plan and Method of Accomplishment Evaluation for the Sanitary System Treatment Capacity Increase were submitted to DOE on August 30, 2004, meeting the PEP milestone requirement. The scope includes closing a sanitary sewage system lagoon and providing minimal necessary infrastructure modifications that would provide a “clean” building site for the new sanitary treatment plant to be constructed via alternative financing. Alternative financing is presently being considered for the entire project. The capital project is on hold pending successful alternative financing arrangements.
- The justification of mission need document for upgrade of the ORNL gaseous waste system was submitted before September 30, 2004, meeting the PEP requirement. It included cost estimates of \$9M to \$11M to disconnect Buildings 3025E, 3525, 3047, and the 4500 complex from the DOE-EM central gaseous waste system, \$2M to upgrade the HFIR area stack, and \$39M to upgrade local gaseous waste systems at the generating buildings. A request for \$0.4M of FY 2005 GPP funding has been submitted in the FY 2005 planning base letter for design of a \$3.2M GPP for a new gaseous waste treatment system for the 4500 complex, disconnecting it from the existing central system.
- The justification of mission need document for upgrade of the ORNL LLLW system was submitted by September 30, 2004, meeting the PEP requirement. It included costs estimates of \$19M to provide LLLW and remote-handled (RH) transuranic waste handling facility infrastructure upgrades needed to replace temporary DOE-EM capabilities implemented for legacy waste. A request for \$1.2M of FY 2005 GPP funding has been submitted in the FY 2005 planning base letter for design of two GPPs for LLLW treatment.

Performance in this area should also be judged by the accomplishments of the Legacy Materials Disposition Initiative. Almost \$2 million was spent in removing legacy materials from ORNL facilities, with the following highlights:

- In support of the LMDI Pump and Motor Campaign, Laboratory Waste Services (LWS) personnel characterized and packaged 1,585 pumps and motors for disposal. With the completion this year of an effort begun in FY 2003, we have processed and disposed of more than 3,500 pumps and motors.
- Approximately 253 cubic meters of LLW were disposed of directly at Envirocare of Utah, Inc., in support of LMDI and HSI.
- Through the LMDI, with support from LWS, facility cleanout and closure activities were conducted at several ORNL and Y-12 National Security Complex facilities: at ORNL; Buildings 0813, 1560, 3003, 3044, 3047, 4505 (attic and basement), 5505, 7848, 7920, and 7930; at Y-12, Buildings 9204-1, 9207A, 9210, 9224, and 9725. The LMDI received HSI funding for the repacking of containers in Building 3047, the removal and disposal of eight gloveboxes at the Radiochemical Engineering Development Center (REDC), and the cleanout of two inactive laboratories in Building 5505.
- The LMDI obtained 20 concrete vaults for possible storage of radioactive remotely handled (RH) materials and initiated inspection and processing of legacy containers.
- About 121 cubic feet of reactive materials were dispositioned.
- LWS supported the cleanout of legacy chemicals in the Chemical Sciences, Environmental Sciences, Fusion Energy, Metals and Ceramics, and Nuclear Science and Technology divisions, transferring many unwanted and excess items to the Chemical Management Center (CMC) for reuse and disposing of the remainder as waste. More than 4,700 excess chemicals have been dispositioned.

- LWS supported division-sponsored facility cleanouts for the Chemical Sciences, Environmental Sciences, Life Sciences, Metals and Ceramics, Nonreactor Nuclear Facilities, and Nuclear Science and Technology divisions.
- LWS supported ongoing research and development and operations activities through the disposition of newly generated waste.

2.4.2 Nuclear Facility Consolidation Composite

Score: 2.33

Rating: Good

Table I.16 provides a summary of ORNL's performance in the nuclear facility consolidation composite.

Table I.16. Components of the Nuclear Facility Consolidation Composite

Milestone	Rating	Score
1. Building 4501	Outstanding	4.0
2. Building 3027	Marginal	0
3. Building 5505	Excellent	3.0
Average	Good	2.33

Milestone 1: Building 4501

Following the depressurization of 25 traps from the Molten Salt Reactor Experiment (MSRE) and their return to Building 3019A, MSRE-related equipment in Building 4501 was placed in cold standby, and a request for recategorization of Building 4501 to less than Hazard Category 3, in accordance with DOE-STD-1027-92 and revised Work Smart Standards (WSS), was submitted to DOE for concurrence in March 2004. Corrective actions from the ORNL Site Office review of the recategorization process were completed in April 2004.

Milestone 2: Building 3027

All accountable radioactive materials were removed from the vault in Building 3027 as of September 28, 2004. Following a verification walkthrough, a letter was forwarded to the ORNL Site Office recommending reduction of the facility's hazard category from Nuclear Facility Category 2 to Radiological Facility. Since there are no fissile or fissionable sources in the facility, the current ^{235}U fissionable equivalent mass (FEM) is 0.0; therefore, the current Nuclear Critical Safety Approval (NCSA), NCSA-57, and all active minor modifications will be processed for cancellation as soon as practicable. The NCSA is not tied to the Safety Basis (SB) Basis for Interim Operation (BIO) and may be canceled before DOE approves cancellation of the BIO. The ORNL Nuclear Materials Control and Accountability (NMC&A) Group has verified inventory removal and is in the process of permanently closing the Building 3027 material balance area (MBA).

All of the repackaging of highly contaminated ^{238}Pu items and the transportation of packaged materials were completed with no contamination incidents or injuries. The achievement of this outcome was the culmination of four years of extraordinary effort during which many barriers were overcome. Discussions are being held with the ORNL Site Office to determine if performance on this outcome is to be determined solely by the schedule (which would yield a rating of Marginal) or by the achievement of a difficult outcome (which could yield a rating of Good).

Milestone 3: Building 5505

The following actions have been completed this fiscal year in support of the recategorization of Building 5505:

- A project plan and schedule were developed and issued. Weekly progress updates are being provided to affected staff and ORNL management.

- The recategorization strategy has been communicated to DOE, and a DOE liaison is participating in weekly meetings and in the WSS process.
- The procedures, Facility Use Agreement (FUA), and training program necessary for operation of Building 5505 as a Radiological Facility have been revised and will be ready to issue on the day of the recategorization.
- Radioisotopes being retained for programmatic use have been separated and are staged to be sealed in special form capsules. This activity was scheduled for completion by the end of the fiscal year.
- A strategy has been developed for calculation of the potential “hold-up” of nuclear materials. Analytical samples have been submitted to various vendors in support of this task.

The following issues have a significant impact on the milestone:

- For several of the radionuclides staged for disposal, the only identified path for disposal is the LLLW treatment system. Bechtel Jacobs Company, LLC, has rejected the request to dispose of these items via that system because of a cumulative strontium-90 equivalency limit that is affecting use of the system throughout ORNL.
- The ORNL Chemical Sciences Division is committed to completion of a short-term project with Lawrence Livermore National Laboratory. Material for this project, which was to have arrived at ORNL in June, has only recently arrived.

These difficulties have been discussed with our DOE customer; the rating assigned to this performance measure is based on the outcomes that have been achieved.

3. EXCELLENCE IN COMMUNITY SERVICE

UT-Battelle is committed to ensuring that ORNL is viewed by its neighbors as a highly valued partner in the region. We deliver on this commitment through active participation in economic development, efforts to strengthen science and math education, and support of the community’s civic and cultural activities.

3.1 GOOD CORPORATE CITIZENSHIP

3.1.1 Enhancing Community Relationships

UT-Battelle will enhance the Laboratory’s role as a valued corporate partner by supporting science education and being a leading participant in major civic endeavors.

Score: 4

Rating: Outstanding

In this year’s PEP, the focus was on recognition of ORNL as a good corporate citizen, with an emphasis on improving the teaching of science in the region and strengthening UT-Battelle’s value as a partner in the region.

Indicator 1: Science Education

There were four activities that UT-Battelle pursued to improve the teaching of science in the region:

- Five new high school science laboratories were funded to \$10K each in Campbell, Knox, Roane, and Scott counties.



As indicated in Table I.17, UT-Battelle's performance in each area indicates a successful effort for a composite score of 3.75 meeting the PEP requirement for an outstanding rating. An in-depth discussion of the activities associated with each indicator is provided in Part II of this report.

Table I.17. Performance criteria and results for technology transfer and economic development,

Criteria	Invention Disclosures	Nondisclosure Agreements	Patents	Licenses	CRADAs and WFOs	Income Royalties and Equity	Company Startups	Company Maturation	Scoring
A		√	√	√	√	√	√	√	7/8 = 0.875
B	√	√	√	√	√	√	√	√	8/8 = 1.0
C	√	√	√	√	√	√	√	√	8/8 = 1.0
D	√	√	√		√	√	√	√	7/8 = 0.875

Sum = 3.75

Targets

Outstanding	Sum ≥ 3.3
Excellent	3.3 > Sum ≥ 2.2
Good	2.2 > Sum ≥ 1.1
Marginal	Sum < 1.1

PART II: SUMMARY OF RESULTS FROM LABORATORY-DIRECTED RESEARCH AND DEVELOPMENT, PROGRAM DEVELOPMENT, AND TECHNOLOGY TRANSFER INITIATIVES

1. INTRODUCTION

Investment decisions made by UT-Battelle in FY 2004 have resulted in outstanding science and technology (S&T) discovery, program growth, and movement of intellectual property (IP) into the marketplace. The investments position the Oak Ridge National Laboratory (ORNL) for leadership of next-generation S&T thrusts and for the transfer of this new knowledge to the commercial sector for the benefit of all. Additional analysis has indicated an improved path forward, used in the selection of proposals for FY 2004 investment funding that looked for tighter linking of proposals with the Laboratory Agenda, investing Laboratory-Directed Research and Development (LDRD) resources for strategic hires, and involving the UT-Battelle core universities in these highly leveraged initiatives.

2. LABORATORY-DIRECTED RESEARCH AND DEVELOPMENT

The objective of the LDRD program is to conduct research and development (R&D) for the purpose of:

- Maintaining the scientific and technical vitality of the Laboratory,
- Enhancing the Laboratory's ability to address future Department of Energy (DOE) missions,
- Fostering creativity and stimulating exploration of forefront S&T,
- Serving as a proving ground for new research, and
- Supporting high-risk, potentially high-value R&D.

To meet these objectives, the Laboratory has established an LDRD program with two components: the Seed Money Fund and the Director's R&D Fund. As summarized in Table II.1, the purpose of the Seed Money Fund is to provide an avenue of support for innovative, risky ideas that "bubble up" during the course of normal DOE programmatic and Work for Others (WFO) activities, while the Director's R&D Fund is used to develop new capabilities in support of the Laboratory Agenda. All projects funded through LDRD must go through a review process, meet the requirements of DOE Order 413.2A and associated requirements, and be approved by the Deputy Director for Science and Technology. In addition, the ORNL LDRD management process is reviewed and approved by DOE annually.

Table II.1. ORNL LDRD Program

	Seed Money Fund	Director's R&D Fund
Purpose	Supports risky ideas	Supports Strategic Plan
Year established	1974	1983
Funding cycle	Continuous	Annual
Proposal review	R&D staff members	Senior management
Project budget	≤ \$125K	≤ \$800K
Project duration	12 to 18 months	24 to 36 months
LDRD outlay	20%	80%

2.1 Resources Provided by the Laboratory

In FY 2004, the LDRD budget authorized by DOE was \$18,550,000, including \$250,000 for capital equipment. As summarized in Table II.2, actual allocations totaled \$15,895,500: \$3,740,000 to the Seed Money Fund, \$12,155,500 to the Director's R&D Fund, and \$40,000 for capital equipment. All capital funds were allocated to Director's R&D Fund projects. Overall, 96.1% of the allocated funds were spent. The expenditure of \$15.3 million was about 2.0% of the Laboratory's total budget of \$751 million for operating expenses and capital equipment, well below the maximum of 6% allowed by DOE Order 413.2A.

Table II.2. FY 2004 ORNL LDRD Allocations and Costs

	Allocations	Costs
Seed Money Fund	\$3,740,000	\$3,622,953
Director's R&D Fund	\$12,155,500	\$11,657,625
Capital equipment	\$85,500	\$40,000
Total	\$15,980,500	\$15,320,578

2.2 Program Outcomes

LDRD supported 116 projects in FY 2004, 59 through the Seed Money Fund and 57 through the Director's R&D Fund. Additional project statistics for each fund are profiled in Table II.3.

Table II.3. FY 2004 ORNL LDRD Breakdown by Fund

	Seed Money Fund	Director's R&D Fund
Costs	\$3,622,953	\$11,657,625
Number of projects	59	57
Number of new starts	35	31
Number of continuing projects	24	26
Average total project budget	~\$100,000	~\$450,000
Average project duration	14 months	24 months

The FY 2004 Director's R&D Fund projects, which accounted of ~77% of the LDRD allocation, were selected to provide support for the R&D needs of the Laboratory's major initiatives in advanced materials, terascale computing and simulation science, complex biological systems, neutron sciences, national security, and three energy-resources initiatives in advanced grid technologies, hydrogen science and technology, and fission to fusion. In addition, the Laboratory used LDRD to recruit strategic staff into positions critical to the success of the Laboratory Agenda. The levels of investment for each initiative and the strategic hires are summarized in Figure II.1. Note that some funds went to a cross-cutting thrust in computational biology and a general category to support projects that did not specifically address a major Laboratory initiative, but were considered important to meeting a need of the strategic plan, such as R&D relevant to upgrading the Holifield Radioactive Ion Beam Facility and the National Transportation Research Center.

In FY 2004, about 23% of LDRD resources were apportioned to the Seed Money Fund to support 59 projects, of which 35 were new (see Table II.3). Of these, 30 were reviewed by the fund's Proposal Review Committee, and the remaining five were small projects recommended by the LDRD manager. As shown in Figure II.2, the Seed Money Fund supported projects across all S&T areas of the Laboratory.

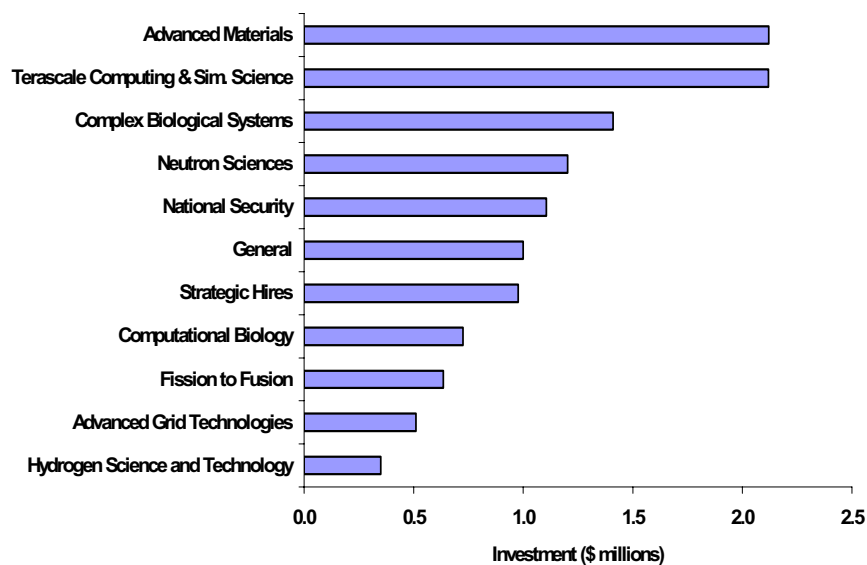


Figure II.1. FY 2004 LDRD Director's R&D Fund investments in the major Laboratory initiatives, strategic hires, and general needs.

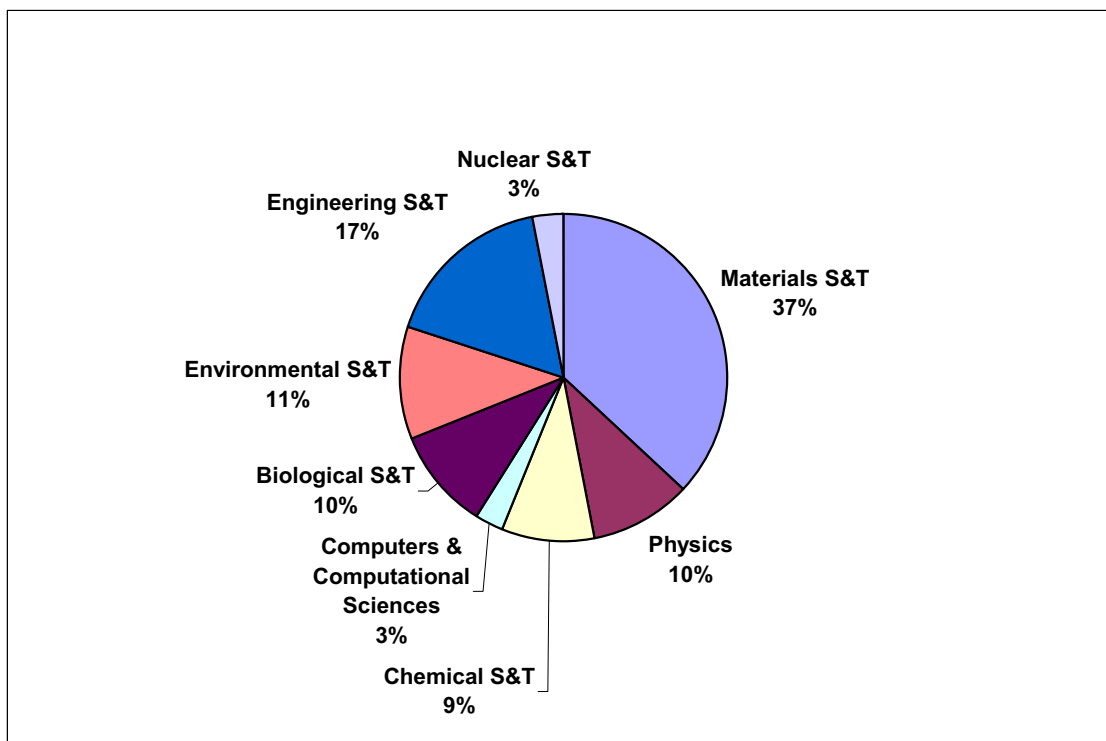


Figure II.2. Distribution of FY 2004 Seed Money by S&T area. The assignment of projects to specific areas is not meant to be definitive, since many projects can be categorized by more than one discipline.

2.3 Analysis of the Outcomes

Our assessment is that the LDRD program is achieving its objectives. This assessment is based on the following actions and activities:

- The [*FY 2003 LDRD Annual Report*](#) (ORNL/PPA-2004/1) and [*Laboratory Directed Research and Development Program, FY 2003 LDRD Self-Assessment*](#) (ORNL/PPA-2004/3) were submitted to DOE on March 31, 2004. The Annual Report describes the technical achievements of the 123 projects funded during FY 2003. The Self-Assessment includes an estimate of the output of the LDRD program and discussions on the relation of the LDRD portfolio to ORNL's strategic plan and initiatives.
- The rigorous review and careful selection of Director's R&D Fund projects during the summers of 2003 and 2004 ensured that the R&D needs of all the major Laboratory initiatives were being addressed and would build the technical foundations for meeting future DOE needs.
- The use of LDRD funds to support strategic hires in the critical areas of advanced materials and neutron sciences.
- The high level of participation by the research staff in the Seed Money Fund, leading to a portfolio of innovative and risky projects at the forefront of ORNL's S&T areas.
- DOE concurrence on all new and continuing projects for FY 2004.
- The implementation of a process to improve the LDRD annual report, which requires that all individual progress reports and final reports must now be reviewed and cleared by the principal investigator's division director or division clearance officer. This process will ensure that all reports meet division standards for technical quality and that reports can be released to the public.

In analyzing the LDRD outcomes for FY 2004, two areas were identified that could be improved:

- Better use of LDRD resources to recruit strategic hires. In FY 2001, the Laboratory began using LDRD as a tool for recruiting new staff by providing funds to support research of critical new hires as they develop their direct-funded programs. Efforts in this area grew during FY 2002–2003. In FY 2003, \$1.55 million of LDRD was used to support research of 12 new staff members; however, this support dropped to \$0.69 million in FY 2004 and provided funds for only nine researchers even though ~\$2 million had been set aside at the beginning of the fiscal year. During FY 2005, additional measures will be taken to encourage the use of LDRD to recruit strategic hire.
- The development of program measures, specifically the tracking of publications derived from LDRD, which would assist in measuring overall performance. In the *ORNL LDRD Program FY 2001 Self-Assessment* (ORNL/PPA-2002/3), it was noted that there was a large discrepancy between the numbers of publications and presentations reported in the LDRD survey and the numbers in the Laboratory's Comprehensive Publications and Presentations Registry (CPPR) database, in which very few publications are attributed to LDRD. Most of the difference between the two sets of data was probably due to the difficulty of getting the Laboratory's researchers to register their work in the CPPR. Not having all publications and presentations registered in the CPPR makes it difficult to accurately assess the output of the LDRD program; however, this is a Laboratory issue rather than an issue specific or exclusive to LDRD. The Laboratory is currently developing a new publications database that should capture LDRD-derived publications. The database should become operational by the end of FY 2005 and the LDRD program fully intends to use this resource. In the meantime, the annual survey of LDRD projects will continue to include a question asking for the number of LDRD-derived publications.

2.4 Impact and Benefit

In attempting to estimate the impact and benefit of LDRD, it must be kept in mind that LDRD is a continuing R&D program that supports more than 100 projects annually, many of which run for more than a year. In addition, these projects are at the forefront of S&T; as a result, their impact may not be felt for years. Finally, the collection of data for the *FY 2004 LDRD Annual Report* and *LDRD Self-Assessment* projects has just begun, and data are not available at this time. Therefore, the following assessment is not specific to FY 2004 projects.

The LDRD program benefits ORNL and DOE by providing the Laboratory with resources for developing new R&D capabilities to better meet the Department's needs; for seeding innovative, staff-initiated research; and for attracting and retaining research staff to maintain the vitality of the Laboratory. The program has a demonstrated record of excellence for innovation and for building the scientific and technological foundations for future programs.

A principal benefit of the LDRD program is that it allows the Laboratory to develop new R&D capabilities in anticipation of future DOE and national needs. In FY 2004 and FY 2005, ORNL will invest about 80% of its LDRD budget to support the R&D needs of the Laboratory's major research initiatives. These initiatives are key to DOE's mission areas. Our intent is to position the Laboratory to effectively support DOE in carrying out its overarching mission of national security through its programs in science, energy resources, environmental quality, and national security. Without LDRD, ORNL would not be able to carry out the cutting-edge R&D needed to accomplish the objectives of the initiatives and position the Laboratory for addressing future DOE and national needs.

In addition to supporting the Laboratory's initiatives, about 20% of the LDRD program budget is used to seed innovative ideas that often arise unexpectedly in the midst of research focused on other objectives. Such an avenue of funding fosters creativity and stimulates exploration at the forefront of S&T and makes it possible to pursue novel research ideas that may have high risk for failure but high potential for making significant advances if the novel concepts are proven. Consequently, such research often leads to new sources of support from DOE or other federal agencies strengthening the core S&T competencies of the Laboratory.

The LDRD program also contributes to maintaining the scientific and technical vitality of the Laboratory by supporting staff-initiated R&D. Such research facilitates high morale in the Laboratory staff by giving them the opportunity to initiate and conduct their most innovative research while their ideas are still fresh and enthusiasm is high. Consequently, the program is a major factor in achieving and maintaining staff excellence at the Laboratory. The LDRD program is also an important tool in the recruiting of new staff to help develop key R&D capabilities critical to the success of Laboratory initiatives.

The ORNL LDRD program is recognized both within the Laboratory and at DOE as an important stimulus for new developments. For example, LDRD has been a contributing factor in about a third of the R&D 100 Awards garnered by the Laboratory during the last decade. Also, about half of LDRD projects report receiving follow-on funding from DOE or other federal agencies.

The LDRD program has been and continues to be of benefit to the Laboratory and DOE. It is a resource for developing new capabilities, for seeding innovative ideas, and for maintaining the vitality of ORNL, and it has a record of excellence for innovation and attracting new support. Through DOE oversight and self-assessments, the LDRD program is continually evolving and improving to ensure the quality of its S&T.

3. PROGRAM DEVELOPMENT

Each year the Laboratory invests a relatively small portion of its overhead resources on program development activities aimed at growing ORNL's budget. These funds are used in areas where program support is not available to perform business development activities (such as writing proposals, developing white papers, conducting workshops, traveling to meetings, and developing marketing materials as appropriate) to secure new work. Most of the program development funds are used on WFO projects. These funds cannot be used to perform R&D.

In FY 2004, the Laboratory's program development budget totaled about \$8.6 million, with about ~75% invested directly in support of the Laboratory Agenda S&T initiatives and the remainder used to support the Laboratory's other core competencies. The Laboratory's FY 2005 budget is expected to grow as a result of these investments. For example, the National Security Directorate brought in \$264 million in new BA during FY 2004, \$84 million more than last year. An analysis of the process indicates that an opportunity for improvement lies in the precision of the determination of "return on investment." Emphasis needs to be placed on the rigor of tracking the source of enabling funds and the resultant new activity.

The emphases for program development investment in each initiative were as follows:

- Neutron Sciences: Establish the Center for Structural Molecular Biology, develop a world-class user program; plan user support facilities; develop the Joint Institute for Neutron Sciences (JINS).
- Complex Biological Systems: Create a consortium for a large-scale GTL facility for characterizing and imaging molecular machines, develop a plan for the GTL facility; develop programs for the Russell Laboratory for Comparative and Functional Genomics.
- Terascale Computing and Simulation Science: Maintain and grow integrated computer and computational science research programs; develop plan for mathematical biology and enabling technologies for DOE's Genomes to Life (GTL) program.
- Energy Resources: Develop and grow programs in (1) advanced technologies for the nation's electrical grid, (2) science and technology for a hydrogen economy, and (3) space nuclear power; grow transportation programs and expand facilities and the NTRC and NTTRC; and establish key S&T partnerships.
- Advanced Materials: Build a nanoscience and engineering program; strengthen soft materials research; and accelerate industrial investments in ORNL; initiate a user program at the Center for Nanophase Materials Science.
- National Security: Grow the national security programs across all fronts. Specific targets include homeland security, intelligence community, defense transformation initiatives, and nuclear nonproliferation.

Some notable program wins were the National Computing Leadership Facility, capture of substantial initial Genomes to Life funding, and 22% growth in new BA for national and homeland security programs. As a result of our Program Development investment, the Laboratory's FY 2005 budget is expected to grow. In summary, the Program Development is well worth the investment.

4. TECHNOLOGY TRANSFER

The achievements of Technology Transfer and Economic Development (TTED) during FY 2004 provide an abundance of evidence of our commitment to "Putting Science to Work" in all of our activities. Our work fosters economic development and the growth of business and industry by making available the

most innovative equipment, the latest cutting edge technology, and the world class expertise of ORNL researchers to technology-based companies throughout the region and beyond.

4.1 Major Organizational Initiatives

TTED offices relocate to main ORNL campus. In March 2004, TTED moved from its longtime office location on Union Valley Road to 4500-North in the heart of the ORNL campus. The move makes us more accessible to our internal customers and provides an excellent opportunity for more interaction with all organizations at the Laboratory.

ORNL sweeps Federal Laboratory Consortium technology transfer awards. For the second year in a row, ORNL received the maximum number (four) of FLC awards allowed; a total of 28 awards were presented. ORNL was the only institution to win four awards. The ORNL excellence in technology transfer awards were for: the “Lab-on-a-Chip” technology, thin-film lithium batteries, microcantilever-based sensors, and robust wireless technologies for extreme-environment communications.

Improved maturation funding process. TTED allocated maturation funds under the new Royalty Sharing Program. A Lab-wide call for proposals was made, and in response, we received 33 proposals. These proposals were reviewed by the Maturation Funding Committee, which is comprised of the Deputy Laboratory Director for Science and Technology, the Director of Strategic Planning and a number of Division/Program Directors. Fourteen proposed projects were chosen and \$584K awarded. Although the final reports for these projects have not yet been received, we are aware of one project that directly resulted in the licensing of a technology, and another that appears to be leading to a license in FY 2005.

New Royalty Sharing Program implemented. TTED instituted a new program to celebrate and recognize the recipients of issued patents, FLC award winners and, for the first time, other key contributors. This recognition was conveyed not only through the distribution of over \$135K, but also through an awards ceremony at which several members of the Leadership Team, including the Laboratory Director, participated.

DOE approves Privately-Funded Technology Transfer. UT-Battelle, with support from DOE, has made a commitment that will provide private funding to further accelerate the maturation of specific ORNL technologies, which with additional testing and development could be commercialized. This is another example of our attempts to bring new and creative means to using our efforts to use our resources and technologies as an economic driver throughout the region and nation. We have also submitted to DOE a proposal for a Use Permit, which would provide a means for UT-Battelle to contract directly with private customers.

TTED has a new Regional Economic Development Director. Tom Ballard, former vice president for Public and Government Relations at the University of Tennessee, arrived on the ORNL scene with 35 years of economic development experience focused on building collaborative relationships in the Southeast. Tom brings to ORNL a wealth of economic development experience, knowledge, and relationships with institutions such as the Southern Growth Policies Board, the Southern Technology Council, state governments, and southern universities.

Alan Liby joins TTED staff. Dr. Alan Liby recently joined TTED. He is working to develop strategies that will increase industrial collaboration and business creation associated with nanotechnology and neutron science. He also will be collaborating on homeland security projects with ORNL and other Tennessee Valley Corridor industries and universities.

New UT President committed to Oak Ridge partnerships. Dr. John Petersen continues to underscore his commitment for strengthening the relationship between ORNL and UT. Dr. Petersen recently attended the Tennessee Valley Corridor Summit to talk about the importance of science and technology development and a well-trained workforce.

Increased technology “shopping” convenience on the ORNL web. Potential licensees can now add technologies to their personal “shopping cart” at the Technology Transfer web site. ORNL listed all candidate technologies based on technology portfolio strategies to facilitate easier access to technologies available for licensing.

4.2 Company Startups and Maturation

ORNL’s technology transfer directorate continues its great success in transferring scientific research to private businesses. Through our technology transfer program, we increase competitiveness within the private sector and promote the use of ORNL’s vast resources, technical expertise, and research.

We positively stimulate the economy. Twelve new companies or new product lines emerged from ORNL technology and/or expertise during FY 2004.

Thirteen CEG clients either moved to the next stage of maturation or completed significant milestones or validation events during FY 2004, as compared to ten clients with stage progressions in FY 2003. Some of this year’s clients have actually progressed more than one stage and have made significant achievement with a total of 18 overall stage progressions or milestones. Stage progression involves achievement of significant milestones or “validations” that mark events usually leading to sustainable operations. Many levels of validations exist between stage movements. Such validations include a successful Proof of Concept event, securing first or significant revenues, signing alliances or partnerships, adding “key” staff, or developing a Board of Directors or Advisor Team.



Dynamax, Inc. licensed ORNL technology associated with the “Automated Soil Gas Monitoring Chamber.” This technology led to a new soil vapor collector product line for Dynamax.

Two companies, based on ORNL technology, have over \$4M in revenues and have graduated from the CEG. Both companies are operationally funded and have over 20 employees.

ORNL is a modern research institution with world-class research facilities, world-renowned researchers, and the desire to work with industry in applying the fruits of that research. TTED carried this message to the FedEx Institute of Technology in Memphis, the East Tennessee Technology Council, the Tennessee Homeland Security Consortium, and a host of economic development leaders in Northern Mississippi among others.



Recent grand opening of the FedEx Institute in Memphis, where staff can meet with businesses interested in obtaining assistance and technologies from ORNL.

ORNL attracts venture capital. Helping the venture capital industry understand important scientific trends such as nanotechnology attracts more capital for the Laboratory’s promising technologies and its licensees. Joint efforts between TTED and Technology 2020 have broadened

ORNL's interaction with venture capitalists. The Laboratory was well represented and highly visible at such events as the Atlanta Venture Forum and the Tennessee Valley Venture Forum.

Battelle Ventures formed to commercialize technology. Battelle announced the formation of Battelle Ventures, a venture capital fund focused on creating, funding, and growing companies from technologies where Battelle is involved. The fund, a 12-year partnership with committed funds of \$150M, will be directed at seed and early-stage technology opportunities. This fund represents another tool for ORNL's commercialization efforts. The initiative will provide licenses and start up companies with greater access to capital as well as an opportunity for sophisticated analysis of technologies, including advice and strategies for commercial opportunities.

4.3 Invention Disclosures, Patents, Licenses, and Royalty Income and Equity

During FY 2004, ORNL filed 109 U.S. patent applications as compared to 86 in FY 2003. Fifty-five patents were issued from the United States Patents and Trademarks Office (USPTO). More importantly, the overall quality of these applications continues to improve as we increasingly factor in market strategies and patent positioning into the drafting of the applications.

TTED focused on the protection of intellectual property this year. We benchmarked and subsequently acquired the Electronic Invention Disclosure Reporting (eIDR) submission system used by Idaho National Engineering and Environmental Laboratory (INEEL). The software has been extensively modified to integrate it with existing ORNL systems such as PartnerWorks and SAP, and is now undergoing extensive testing. When fully implemented, the eIDR system should provide a faster and more efficient submission process for invention disclosures, with the potential saving of greater than \$200,000 annually. This savings estimate is based on an analysis comparing time and effort of the inventor, co-inventors, R&D administrative staff, patent agents, and paralegals to manually compile, route, and submit invention disclosure information versus conducting these activities electronically.

The adoption of this eIDR software was the first priority established by the newly instituted PartnerWorks Change Control Board (PWCCB). The PWCCB is comprised of Laboratory research division users, Office of General Patent Counsel staff, a TTED Commercialization Manager (CM) and an administrative staff member. The Board was formed to prioritize functional changes to PartnerWorks and manage the associated budget.

ORNL substantially expanded the technology transfer section of the annual group leader training course with a focus on the protection of intellectual property through disclosing of inventions and the use of Nondisclosure Agreements. The Office of General Patent Counsel and TTED Commercialization Managers are placing emphasis on working with inventors to identify and facilitate submission of invention disclosures.

ORNL increased its patent budget in FY 2004 both directly and indirectly. The indirect increase resulted from an analysis and paring down of \$250K in existing cases and there was a direct increase in funding of \$300K to the patent budget.

Through the implementation of a policy to file all new patent applications as "small entities," we anticipate a substantial cost savings in patent filing, issuance, and maintenance fees. Fees for filing an application as a small entity are approximately half the cost of those for filing as a large entity.

The Technology Transfer organization instituted a new program to celebrate and recognize patent recipients and, for the first time, other key contributors. This recognition was conveyed not only through

the distribution of over \$135,000, but also through an awards ceremony at which several members of the Leadership Team, including the Laboratory Director, participated.

In FY 2004 TTED executed ten new patent licenses and an additional thirteen copyright licenses. We also initiated a formal partnering agreement, Beta Test Agreements (BTAs), for companies wanting the Laboratory to do software/product testing. TTED executed seven such licenses this year.

TTED is aggressively seeking opportunities to co-license bundled, similar, and complementary technologies with other DOE Laboratories and UT-Battelle Core Universities in an effort to stimulate an increase in licensing.

4.4 CRADAs and WFOs

TTED negotiated a \$15M agreement with Canada for the construction of the first Spallation Neutron Source instrument. The Canada Foundation for Innovation is funding this Work for Others (WFO) agreement for the design and construction of the “Vulcan” beamline—a neutron diffraction instrument to be used for engineering materials applications. Under this grant, Canada’s McMaster University in Hamilton, Ontario, will work with ORNL and the University of Tennessee.

Today, some of ORNL’s most exciting technology transfer partnerships address advancements in healthcare and homeland security. ORNL and Mobile Clinics International (MCI) have signed a WFO agreement to apply ORNL’s specialized research and technical resources in the development of a concept for a fleet of vehicles to be used by MCI in the prototype development of mobile medical clinics. These mobile medical clinics will provide education, screening, diagnosis, and treatment of HIV/AIDS, tuberculosis, and malaria in Sub-Saharan Africa.

Oak Ridge National Laboratory (ORNL) is the lead Laboratory among five Department of Energy National Laboratories conducting research and development of a retinal prosthesis with Second Sight, LLC, through a \$19M, three-year Cooperative Research and Development Agreement (CRADA). The goal is to develop implants containing electrodes that will be positioned on the retinas of those blinded by diseases such as age-related macular degeneration (AMD) and retinitis pigmentosa (RP). The retinal prosthesis is capable of capturing visual information, bypassing damaged photoreceptors and electrically stimulating viable retinal layers, which could result in limited visual recovery.

ORNL researchers are also providing their scientific and technological expertise in sensors for the detection, identification and monitoring of radiological shipments in-commerce to the South Carolina State Transport Police as part of the 21st Century Commercial Vehicle Inspection Initiative and the Commercial Vehicle Information Systems and Networks Initiative. This is currently a joint effort among the State of Tennessee Department of Safety, DOE, ORNL, the South Carolina Department of Safety and the South Carolina Transport Police Division. ORNL has deployed these technologies at the I-40/I-75 Weigh and Inspection Station in Knoxville, Tennessee.

Feedback from some ORNL User Facilities indicated the need for a contracting mechanism which would cover collaborative work and could be implemented quickly. TTED and the Office of General Patent Counsel developed the Fast-Track CRADA and obtained DOE approval for a shortened approval process.

The return on investment from partnerships (funds-in), royalties, and user agreements was \$28,041,990 for FY 2004. The overall amount is up approximately 25% from the same date last year, with the increase coming from WFO and royalties. CRADA funds-in is at approximately the same level as last year.

4.5 Nondisclosure Agreements

We are processing Nondisclosure Agreements (NDAs) more efficiently and developing new agreements with shortened approvals. TTED's Sponsored Research group assumed responsibility for all NDAs and implemented a new approach with assistance from the Office of General Patent Counsel. This guidance provides rationale for acceptable and unacceptable NDA terms. We have been successful in persuading many outside companies and academic institutions to use ORNL's standard NDA agreement instead of their own. This has reduced the amount of negotiating time spent by TTED and General Patent Counsel by eliminating the need to bring outside NDAs into compliance with DOE requirements.

PART III: SUMMARY OF RESULTS FROM INFRASTRUCTURE IMPROVEMENT, OPERATIONS IMPROVEMENT PROGRAM, AND LABORATORY RESERVES-FUNDED INITIATIVES

1. INTRODUCTION

UT-Battelle continues to demonstrate an aggressive approach in implementation of the long-term strategic plan to upgrade the Oak Ridge National Laboratory (ORNL) infrastructure. The physical improvements are the most obvious and tangible of the many demonstrations of our continuing pursuit of growth at the Laboratory. Major accomplishments include:

- Beneficial occupancy of the new Central Laboratory and Office (CLO) Building; relocation of 526 personnel during FY 2004 resulting in a total of approximately 800 people moved back on campus since the beginning of our consolidation efforts;
- Completion of construction of the Advanced Microscopy Laboratory and the 7625 High Bay Building to support significant research initiatives and completion of the Fire Protection and HVAC Line Item Projects as well as the Research Support Center and numerous smaller upgrades of the ORNL infrastructure;
- Deactivation and/or demolition of a total of 108,126 square feet of space in FY 2004, and Building 9204-3 (Beta 3) was vacated and placed in standby (255,656 square feet). To date, a total of 1.5 million square feet of space has been vacated against our original goal of 1.8 million square feet of space;
- The *Preliminary Proposal for the Bethel Valley Process Waste Cooling Water Elimination* was submitted to DOE on July 6, 2004, in advance of the PEP requirement of August 30, 2004;
- A *Project Plan* and *Method of Accomplishment Evaluation* were submitted to DOE for the Sanitary System Treatment Capacity Increase on August 30, 2004, meeting the PEP milestone requirement;
- The justification of mission need document for upgrade of the ORNL gaseous waste system was submitted by September 30, 2004, meeting the PEP requirement, and
- The justification of mission need document for upgrade of the ORNL LLLW system was submitted by September 30, 2004, meeting the PEP requirement.

These initiatives were accomplished in addition to activities associated with the core mission objectives of the Laboratory. The successful execution of these efforts and others demonstrate an effective and strategic management philosophy for positioning the Laboratory for sustained world-class growth in support of the Department of Energy (DOE).

2. INFRASTRUCTURE IMPROVEMENTS

The focus on infrastructure improvements continues to produce dramatic changes at ORNL. Most visibly, beneficial occupancy of the CLO was achieved on June 30, 2004. This represents completion of another milestone in a series of extremely successful modernization activities. Additionally, 526 personnel moves, 237 more moves than initially planned, were completed which allowed the CLO to become integrated with the rest of the Laboratory. These moves also facilitated the vacating of leased and older facilities that consume funds, large amounts of energy, cost more to maintain, and present higher risk.

Other UT-Battelle infrastructure improvement efforts made outstanding progress toward the goal of delivering new facilities to the Laboratory. Two major DOE Line Item projects were completed during the year. The Fire Protection Systems Upgrade (\$5.9M) and the Laboratory Facilities HVAC Upgrades (\$7.1M) were completed on or ahead of scheduled and under budget. The HVAC project completed Critical Decision-4 in January, three months ahead of schedule, and was recognized in complementary notes from the DOE HQ customer.

Several smaller, but important projects, were also completed. The Advanced Materials Laboratory (AML) Project met a PEP milestone successfully for substantial completion at the end of February. The unique design of this facility was recognized internally and in an August issue of *Tradelines*, a major industry publication. The 1506 greenhouse renovation was completed during August, representing another unique new research facility for ORNL. The first State funded facility, JICS/ORCAS was substantially complete on June 4; design is ongoing for the other two facilities. The CNMS, one of several key nanophase facilities being constructed by DOE, is on schedule. A recent review led by Dan Lehman of DOE HQ was extremely complimentary of the project, validated the FDD management systems for the project, and resulted in very few corrective actions, none of any significance.

In addition to these DOE funded projects, the initial state-funded facility, the Joint Institute for Computing Sciences, was completed during the year and design is under way on the other two State Facilities. The final private-sector-funded building planned for the East Campus has been conceptualized and the schematic design is complete. Work is ongoing in support of projects for upgrade of the ORNL substation, in conjunction with TVA. The final landscaping to complete the East Campus is under way with an innovative Guaranteed Maximum Price 8(a) contract.

In support of the initiative to provide open access to ORNL's facilities, numerous upgrades were made to parking lots and traffic patterns. Two new parking lots on the sites of the former GAAT and SIOU remediation sites have been opened in the central campus for open parking by staff. These upgrades significantly improve the safe and efficient access to and from our facilities. An additional parking lot has been designed for the East Campus and is on an accelerated schedule for construction early in FY 2005.

A total of 108,126 square feet of space was deactivated and/or demolished in FY 2004. Building 9204-3 (Beta 3) was vacated and placed in standby (255,656 square feet). To date, a total of 1.5 million square feet of space has been vacated against an original goal of 1.8 million square feet of space. The combined strategy of returning usable space at the Y-12 National Security Complex to the National Nuclear Security Administration (NNSA), transferring space to other site contractors, selling appropriate space, and demolishing unusable facilities continues to be effective in moving us toward our goal of vacating 1.8 million square feet by the end of the campaign. Facility Deactivation progress was achieved in the shutdown of the Biology Complex at Y-12. FDD undertook a high payoff strategy to invest the utility savings from the second half of the fiscal year to achieve shutdown of the area by March 31, 2004. The shutdown was achieved on schedule through complex and difficult integration of both ORNL and Y-12 resources. The project also received high marks for compliance with a DOE Fire Protection review resulting in unusual high praise and absolutely no findings.

The *Preliminary Proposal for the Bethel Valley Process Waste Cooling Water Elimination* was submitted to DOE on July 6, 2004, in advance of the PEP requirement of August 30, 2004. A request for \$0.5M of FY 2005 GPP funding has been submitted in the FY 2005 planning base letter for the \$3.1M GPP to start design and construction on initial high-priority buildings next fiscal year.

A project plan and method of accomplishment evaluation documents were submitted to DOE for the Sanitary System Treatment Upgrades on August 30, 2004, meeting the PEP milestone requirement. The scope included closing a sanitary sewage system lagoon and providing minimal necessary infrastructure

modifications that would provide a “clean” building site for the new sanitary treatment plant to be constructed via alternative financing. Alternative financing is presently being considered for the entire project. The capital project is on hold pending successful alternative financing arrangements.

The justification of mission need document for upgrade of the ORNL gaseous waste system was submitted by September 30, 2004, meeting the PEP requirement. It included costs estimates of \$9 million to \$11 million to disconnect Buildings 3025E, 3525, 3047, and the 4500 complex from the DOE-EM central gaseous waste system, \$2M to upgrade the HFIR area stack, and \$39M to upgrade local gaseous waste systems at the generating buildings. A request for \$0.4M of FY 2005 GPP funding has been submitted in the FY 2005 planning base letter for design of a \$3.2M GPP for a new gaseous waste treatment system for the 4500 complex, disconnecting it from the existing central system.

The justification of mission need document for upgrade of the ORNL LLLW system was submitted by September 30, 2004, meeting the PEP requirement. It included a cost estimate of \$19M to provide LLLW and remote-handled transuranic waste handling facility infrastructure upgrades needed to replace temporary DOE-EM capabilities implemented for legacy waste. A request for \$1.2M of FY 2005 GPP funding has been submitted in the FY 2005 planning base letter for design of two GPPs for LLLW treatment.

3. OPERATIONS IMPROVEMENT PROGRAM

The objective of the Operations Improvement Program (OIP) is to invest in a set of operational improvement initiatives, identified through self-assessment, which would significantly improve the Laboratory’s work processes. Proposals are reviewed by a team of mid-level managers and by the ORNL Risk Ranking Board. Overall, the selected proposals are well executed and provide outstanding return on investment.

Prior to the start of the fiscal year, the FY 2004 OIP stack element had been set by the Leadership Team at \$750K. The submitted 23 proposals requested a total of \$3.6M. Using recommendations supplied by a group of S&T support managers and by the ORNL Risk Ranking Board, the Leadership Team selected three proposals for funding. In June 2004, a new project, the Publication Tracking System, was added. New funding of \$40K was added and funding levels within ongoing projects were adjusted to take advantage of the new opportunity. The final amount costed for the four investments was \$777K.

3.1 Liquid and Gaseous Waste Treatment Facility Reengineering

This OIP project is in the second year of a multi-year effort to

- Eliminate the need for ORNL facilities to use the outdated and expensive existing central liquid and gaseous waste treatment facilities currently operated by DOE Environmental Management (EM),
- Assist generators in re-engineering the liquid and gaseous waste systems, and
- Complete the Facility Process Evaluations initiated under the Facility Environmental Vulnerability Assessment Recommendations Implementation OIP initiative.

The FY 2004 funding was \$520K; the total investment to date is \$1.095M.

This year’s OIP effort resulted in the following results.

- Submitted the *Preliminary Proposal for the Bethel Valley Process Waste Cooling Water Elimination* to DOE on July 6, 2004, meeting the PEP task schedule of August 31, 2004, ahead of schedule.

- Completed an engineering study for the Sanitary Treatment System Upgrades and started an engineering project to evaluate private sector funding options for the project. A project plan was submitted to DOE on August 30, 2004, meeting the PEP schedule for this task.
- Prepared cost estimates for gaseous systems upgrades for buildings 4500N, 4501, 4505, 3025E, 3525, 7910, 7920, 7930, and 7911. Initiated testing of the 7911 and 2026 stacks to determine whether they meet new ANSI standards. Developed justification of mission need documentation for a FY 2005 GPP to disconnect 4500N, 4501, and 4505 from the central gaseous system and a line item for the remainder of the gaseous system to meet the September 30, 2004, PEP milestone.
- Completed engineering studies and feasibility-level cost estimates for the new LLLW treatment system to be located at the 7900 area. Developed justification of mission need documentation to meet the September 30, 2004, PEP milestone for a series of GPPs beginning in FY 2005 to be disconnected from the central LLLW system by FY 2009 when DOE EM LLLW treatment ends.
- Submitted a request for FY 2005 OIP funding to continue engineering analysis to support implementation of the strategic plan.

All activities were completed on schedule and within cost.

3.2 Disposal of Special Nuclear Materials

Operations Improvement Program funds of \$120K were provided to complete the de-inventory of the Special Nuclear Material Storage Vault at Building 3027 and to enable the reclassification of the building from a Hazard Category 2 nuclear facility to below the Hazard Category 3 threshold by April 30, 2004. This activity is also captured in Performance Indicator 2.4.2, Milestone 2.

All accountable radioactive materials were removed from the Building 3027 Vault as of September 28, 2004. Following a verification walk-through, a letter was forwarded to the ORNL DOE Site Office recommending the facility categorization be reduced from nuclear safety Category II to Radiological. Since there are no fissile or fissionable sources in the facility, the current ^{235}U FEM is 0.0, the current NCSA (NCSA-57) and all active minor modifications will be processed for cancellation as soon as practicable. The NCSA is not tied to the Safety Basis BIO and may be canceled prior to DOE approval to cancel the BIO. The NMC&A group has verified inventory removal and is in the process of permanently closing the Building 3027 material balance area (MBA).

It is noteworthy that all of the repackaging of highly contaminated ^{238}Pu items and the transportation of packaged materials were completed without any contamination incidents or injuries.

This outcome, achieved at the end of the fiscal year, came as the result of four years and \$750K of OIP-funded effort to overcome many barriers.

3.3 Evaluation of Options for Downgrading Building 5505 to a General Radiological Facility

The goal of this project is to:

- Outline the options for downgrading Building 5505 to a general radiological facility, and
- Record descriptions and cost estimates for the tasks that would be required and prepare a project plan and schedule for the necessary actions.

This project was initially funded at \$110K; the funding was decreased to \$90K in June 2004 to allow for funding another opportunity.

The activity is part of the Laboratory's Hot Cell Consolidation effort. The outcome of this project is included as part of the FY 2004 Performance Evaluation Plan as Milestone 3 of Performance Indicator 2.4.2.

The following actions have been completed this fiscal year in support of Milestone 3:

- A project plan and schedule were developed and issued. Weekly progress updates are being provided to affected staff and ORNL management.
- The strategy for recategorization has been communicated to DOE and a DOE liaison is participating in weekly meetings, as well as the Work Smart Standards Process.
- The procedures, Facility Use Agreement, and Training Program which is necessary for operation of Building 5505 as a radiological facility, have been revised and will be ready to issue on the day of the recategorization.
- Radioisotopes being retained for programmatic use have been separated and are staged to be sealed in special form capsules. There are no known barriers to completion of this activity by the end of the fiscal year.
- A strategy has been developed for calculation of the potential "hold-up" of nuclear materials. Analytical samples have been submitted to various vendors in support of this task.

The following issues have developed that significantly impact the milestone:

- Several of the radionuclides staged for disposal have only one identified path for disposal. That route is through the LLLW treatment system. Bechtel Jacobs Company, LLC, has rejected the request to dispose of these items via that system due to a cumulative strontium-90 equivalency limit that is affecting use of the system throughout ORNL.
- Chemical Sciences Division is committed to completion of a short-term project with Lawrence Livermore National Laboratory. The material which was to have arrived in June has only recently arrived.

Additional details are discussed further in the Part I of this report.

3.4 Publications Tracking System

The goal of this project is to develop a user-friendly, web-based tool that will be useful to research divisions and Laboratory management to track information associated with Scientific and Technical Information documents. This project was added in June 2004 and funded at \$60K – \$20K in redistributed, and \$40K in new funds. This project will extend into FY 2005. OIP funding was used in FY 2004 to develop a prototype web page and to perform database-in-development tasks. The overall project plan calls for limited piloting in January 2005 with full implementation of the system in June 2005.

4. LABORATORY RESERVE–FUNDED INITIATIVES

Laboratory Reserve funds are used to finance new opportunities, maintain momentum within existing improvement agenda activities, or deal with uncontrollable events. In comparison to infrastructure improvement and OIP, these reserve-funded activities are subject to fewer planning requirements and less project rigor to enable flexibility to respond to specific, well-bounded needs in real time. Overall, they

provide outstanding return on investment. During FY 2004, ten activities, listed in Table III.1, received Laboratory Reserve Funds totaling \$7.158M.

Table III.1. Initiatives receiving Laboratory Reserve funds in FY 2004

Description	Manager	Funding (\$K)
Senior Advisors for Nuclear Operations	Smith	150
Legal Outside Counsel	Porter	200
Site and Facility Electric	Debban	40
Red Hat License	Turner	100
FY 2000 Lawsuit Settlement	Smith	800
Offset Account	Smith	4,368
Bush Visit	Debban	500
Harris Support	Wadsworth	250
Gilliland Support	Wadsworth	250
FMD Special Projects	Debban	500

PART IV: OPERATING EXPERIENCE ANALYSIS

1. INTRODUCTION

A review of operating experience information at ORNL in FY 2004 provides several indications that we are making progress toward our goal of decreasing significant abnormal events and precluding identification by external entities of significant deficiencies that we do not already know about. In addition, both internal audits and external oversight show that we are generally improving our ability to respond to abnormal events and conditions.

Considerable work remains to be done in enhancing our overall effort in reporting, analyzing, and responding to abnormal events. We are continuing to build expertise in the use of the Assessment Tracking System (ATS) to support a more robust analysis of abnormal events and external oversight data. As part of this improvement effort, we are enhancing our tool, ATS, by designing more user-friendly screens, streamlining the data management, and expanding the reporting function. The information gathered from the Focus Groups has defined and driven the planned improvements. Overall, we expect to achieve our goal of delivering improved data management and information analysis functions to our customers.

2. MANAGEMENT OF SELF-DISCLOSING EVENTS AND CONDITIONS

ORNL has an extensive program to identify, properly evaluate, and report abnormal events and conditions. The goal of our reporting programs is to identify the causes of problems and put in place effective corrective actions that will prevent recurrence. A number of factors indicate that line management and staff have embraced the concept of identifying and reporting problems, concerns, incidents, and associated issues as the first step in finding solutions and implementing systemic improvements. These factors include the increased use of critiques to more fully discern and alleviate operational barriers and the consistent identification of issues that reach occurrence reporting thresholds through self-assessing or self identifying processes.

2.1 Environmental Incidents

UT-Battelle delivered outstanding environmental performance during FY 2004.

- There were no reportable releases to the environment at ORNL.
- There was one significant finding from inspections conducted by regulators, indicating that UT-Battelle remains cognizant of and responsive to the expectations of our regulator organizations.
- There were four National Pollution Discharge Elimination System (NPDES) permit nonconformances attributed to UT-Battelle activities.

UT-Battelle has been able to deliver this performance as a result of organizational effectiveness in combination with the maturity of our regulatory compliance and waste management programs.

Environmental Protection Services reached a major goal by achieving ISO 14001 registration in July. This accomplishment provides evidence that UT-Battelle's Environmental Management System (EMS) is an effective tool to manage, control, and measure environmental impacts. The ISO 14001 EMS is designed and deployed to improve environmental performance, ensure compliance with regulations and

other requirements, improve effectiveness and efficiency, reduce costs, and earn and retain regulator and community trust.

UT-Battelle environmental compliance performance by operating and research organizations implementing these programs was sustained another year. Challenges included reduced EP&WSD oversight of UT-Battelle activities, as well as diversion of key EP&WSD core resources to the development of the EMS and major legacy material removal initiatives. This sustained level of performance is attributed to the line organization's increased ownership, and utilization of deployed resources such as Environmental Compliance Representatives (ECRs), Waste Services Representative (WSRs) and other technical support personnel, as well as the strengthening of EMS subject areas and procedures.

2.2 Worker Safety and Health

As indicated in Figure IV.1, ORNL has been increasingly successful in reducing work-related injuries and illnesses over the past five years.

While this success is commendable, we must continue to focus on delivering further improvements if ORNL is to reach its potential as best in class among the national laboratories.

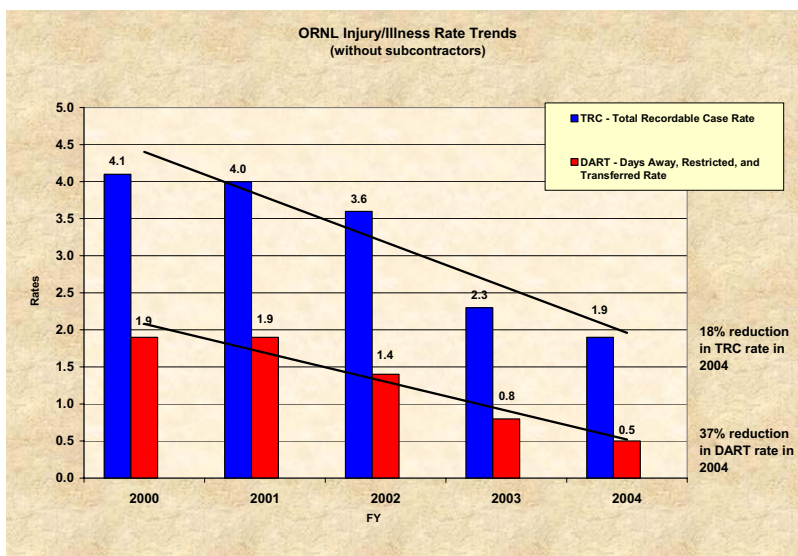


Figure IV.1. Trends in illnesses and injuries at ORNL for FY 2000–FY 2004

2.3 Radiological Events

In FY 2004, 226 Radiological Event Reports (RERs) were filed, 69 more than the 157 RERs filed in FY 2003. As indicated in Table IV.1, increases occurred mainly in contaminations of equipment or material and discovery of contaminated areas. Many of these occurred during our continuing efforts to move personnel from old areas with legacy contamination to newer facilities. There was also a slight increase in radiological procedure violations and poor radiological control practices as the Nonreactor Nuclear Facilities Division (NNFD) continued implementing more rigorous controls in nuclear operations and as the Research Reactors Division (RRD) upgraded and implemented a more thorough performance assessment function.

Table IV.1. Radiological events at ORNL

Category	FY 2003 Events	FY 2004 Events
Contamination of equipment/material	69 (40%)	109 (48%)
Contamination of company clothing	15 (9%)	9 (4%)
Contamination of area	23 (13%)	40 (18%)
Violation of radiological procedures		
Radiological control practices	16 (9%)	9 (4%)
Radiological protection procedures	15 (9%)	6 (3%)
Radiological posting requirements	9 (5%)	6 (3%)
Total violation of radiological procedures	24 (14%)	21 (11%)
Radiological work permit (RWP) violation	4 (2%)	2 (1%)
Other		
Airborne contamination	4 (2%)	14 (6%)
Skin contamination	6 (3%)	8 (4%)
Contamination of personal clothing	2 (1%)	3 (1%)
Contamination of vehicle	1 (1%)	1 (1%)
Uncontrolled release of radioactive material	1 (1%)	5 (2%)
Leaking source	2 (1%)	2 (1%)
Uncategorized	5 (3%)	
Total other	21 (12%)	
Not Classified		2 (1%)
Unplanned Internal Uptake		2 (1%)
Other		8 (4%)

2.4 Occurrence Reporting

The Occurrence Reporting and Processing System (ORPS) Program is intended to ensure the timely collection, reporting, analysis and dissemination of information concerning environmental, safety and health issues. The purpose is to ensure that the Department of Energy (DOE) is informed of events and issues that could adversely affect the health and safety of the public or workers, the environment, the intended purpose of DOE facilities, or the credibility of DOE. This end-of-year summary includes the set of occurrence reports filed by ORNL since the implementation of the DOE Occurrence Reporting and Processing System (ORPS) redesign. The redesigned ORPS criteria set was implemented at ORNL on November 1, 2003.

A number of factors evidenced by this year's occurrence reporting results continue to demonstrate the strong emphasis and endorsement by UT-Battelle management for an open problem-reporting environment. Positive results have included a strengthening of Laboratory-wide self-assessment efforts and the critique process, increased participation by staff at all levels in the problem identification and causal analysis processes, a reduction in the number of issues discovered through self-disclosed events, and a commensurate increase in those found through assessment activities.

Occurrence Reporting Criteria

As indicated in Figure IV.2, we saw a continuing shift in the types of occurrences submitted to the DOE ORPS during FY 2004. Occurrences meeting the reporting criteria of Near Misses and Potential Concerns represent 10% of the reported occurrences. These two criteria are most encompassing for issues that, in many cases, have no actual adverse result, yet present situations where staff members discern a need for

additional analysis because of potential impacts. In contrast, the Near Miss/Potential Concerns criteria set represented 31% during FY 2003. Though the Near Miss issues were moved to the Management Concerns/Issues criteria group under the re-designed ORPS reporting criteria, we still observe a steady multi-year decrease in these potentially impacting issues.

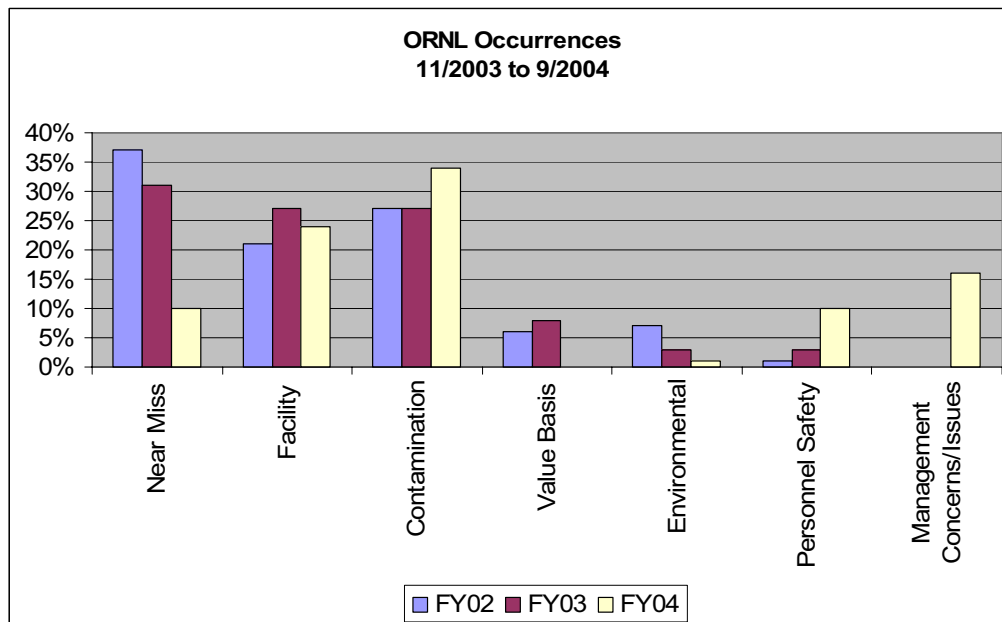


Figure IV.2. ORNL Occurrences by Criteria

Contamination/Radiation control (legacy contamination) issues comprised 34% of the total occurrences during the past year. This figure appears to be a function of three main factors: progressively aging facilities, efforts to clean out and/or decommission older facilities, and a strong focus on facility-based self-assessment activities. As we continue our effort to dispose of older facilities, we are identifying legacy issues that are, in some cases, decades old. This fact, coupled with the progressive improvement in the depth and quality of our self-assessment efforts, have led to an increase in the identification of contamination and radiological control issues, especially those associated with legacy conditions.

We also continue to see a remarkable trend toward the near-elimination of personnel radiation protection issues reported through ORPS. During the reporting period, we experienced only one occurrence in the personnel contamination category. This low level of incidence highlights the Laboratory-wide improvements in the consistency and pervasiveness of our radiological controls at the institutional level.

Reports related to Facility Status and Condition issues are 24% of this period's occurrences and have steadily increased as our facility review activities mature, and the operating safety basis of our nuclear facilities improves. The increased level of these types of reports is indicative of the additional rigorous operational approach and expectations we are instilling in our staff and the increased rigor of self-assessment activities undertaken by the Non-reactor Nuclear Facilities and Research Reactors Divisions. Contributing to the number of reports associated with this occurrence category are facility-aging/resource-sensitive factors including a lack of necessary upgrades, inadequate preventive maintenance activities, and high inconsistency in facility-based extended life programs.

Two new categories under the redesigned ORPS reporting criteria – Management Concerns/Issues and Personnel Safety – represent, respectively, 16% and 10% of the total for this reporting period.

Management Concerns/Issues include situations that are not necessarily reportable, but were considered to be of a potential level of concern or representative of a near-miss condition that warranted reporting in order to convey needed information to the Laboratory, other complex contractors, and DOE. Personnel Safety concerns show a steep increase because of the significantly broadened criteria set for these types of issues introduced through the redesign of the ORPS criteria. A number of types of injuries that were not classified as occurrences in FY 2003 are now clearly within these injury-related criteria.

ORPS Occurrence Significance Categories

The categorization information in Table IV.2 is pertinent because it indicates that the overwhelming majority of ORNL's occurrences during the last year were identified at the bottom end of DOE's significance scale. Taken together, the two lowest occurrence categories (3 and 4) comprise 84% of the total reports for this time period. Category 4 represents 66% of all occurrence reports. This indicates that the training and support provided to Laboratory personnel associated with the occurrence reporting function, has been effective in conveying the need to report at the lowest levels of the established ORPS criteria thresholds. Figure IV.3 displays the significance criteria by month; it shows that the majority of reportable issues or events (categories 3 and 4) occurred during December 2003, February 2004, June 2004, and August 2004.

Table IV.2: ORPS Significance Categories

Significance Category	Total Quantity	Percentage
OE, Operational Emergency	4	4%
SC-1, Significant Impact on Safety, Facility Operations	1	1%
SC-2, Moderate Impact on Safety, Facility Operations	10	11%
SC-3, Minor Impact on Safety, Facility Operations	17	18%
SC-4, Some Impact on Safety, Facility Operations	62	66%

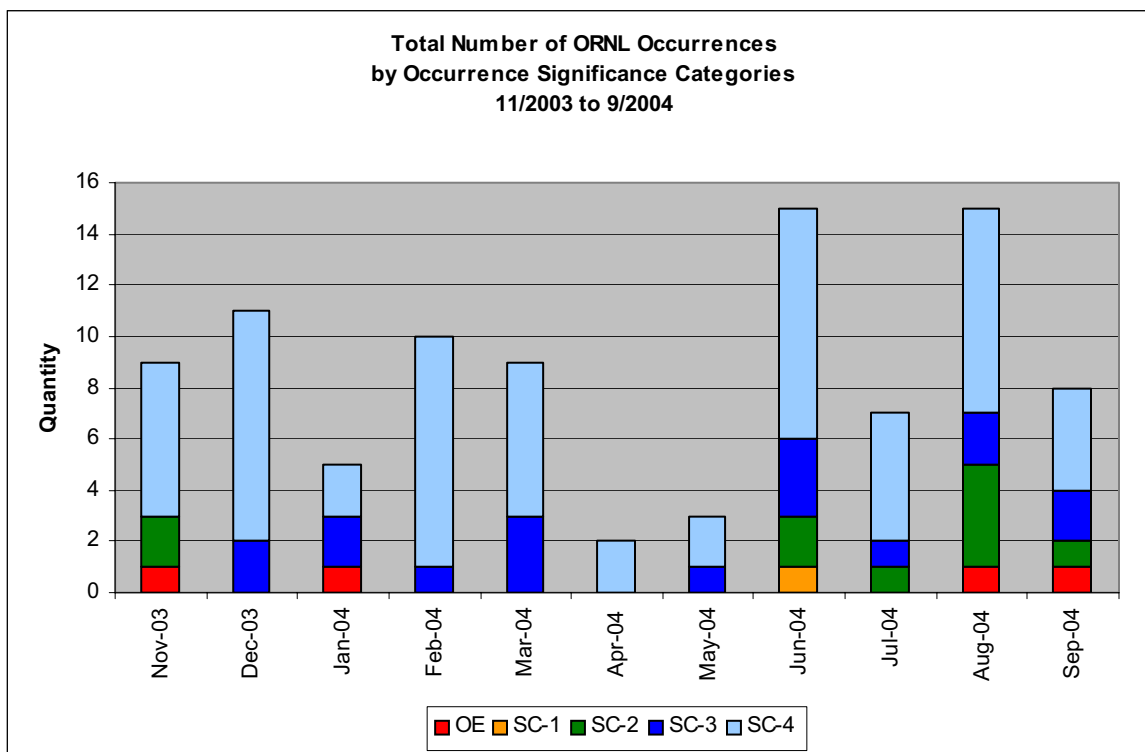


Figure IV.3: ORPS Significance Categories by Month

Self-Assessment and Self-Disclosed Occurrences

We continue to see a positive bias toward identification of occurrence reports through our self-assessment/identification processes in Figure IV.4, as opposed to self-disclosed, event-driven origins. For FY 2002, 39% of occurrences were found through self-assessment. For FY 2003, this figure was 46%; the last eleven months show that 60% have been found through this proactive approach to problem identification. This appears to indicate that our self-assessment activities have the clear potential to allow us to identify problems before they rise to thresholds requiring occurrence reporting as we begin to analyze this information identified through the conduct of line organization assessment activities. There were eight months where the numbers of self-assessment occurrences were greater than the self-disclosed occurrences.

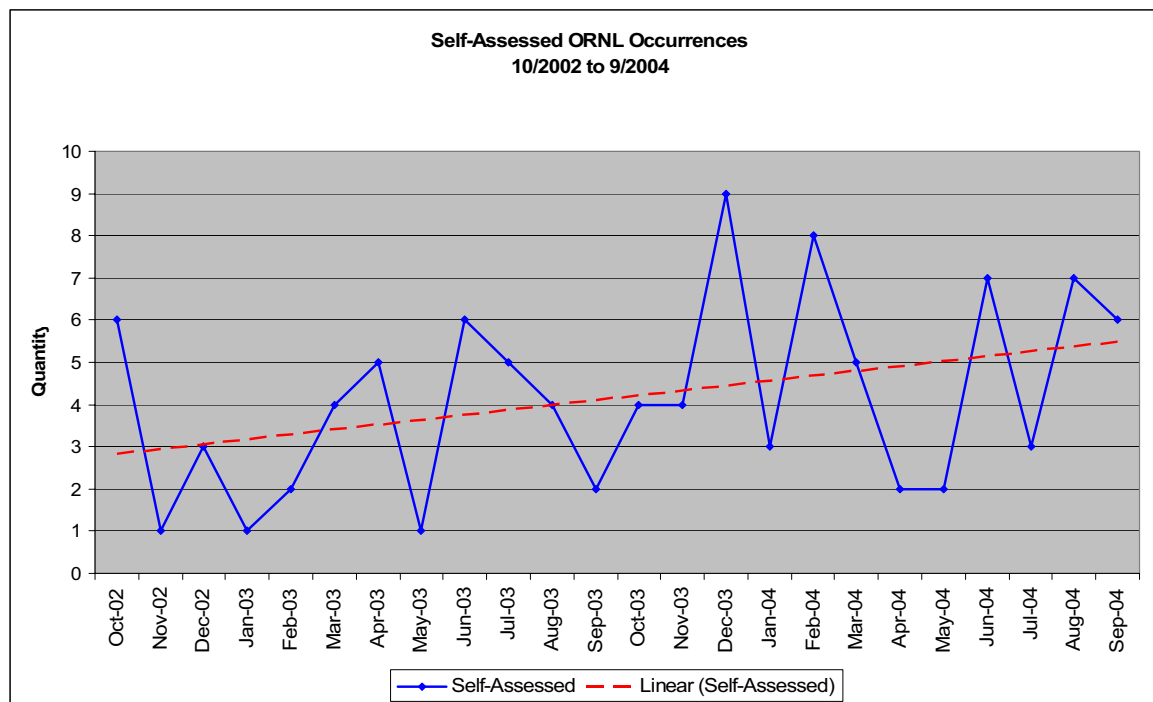


Figure IV.4: Self-assessment/Identification

ORPS Occurrence Cause Codes

Issues were reviewed and apparent cause codes were identified where some were assigned more than one cause from the ORPS Causal Analysis Tree in the DOE G231.1-2, Occurrence Reporting System Causal Analysis Guide. The Causal Analysis Tree is a structure designed to describe apparent causes for problems within operating facilities.

Figure IV.5 shows the quantity of reported occurrence cause code categories. The majority of the problems fell into “Skill Based Errors”, “Work Organization and Planning less than adequate (LTA)” and “Material Control LTA”.

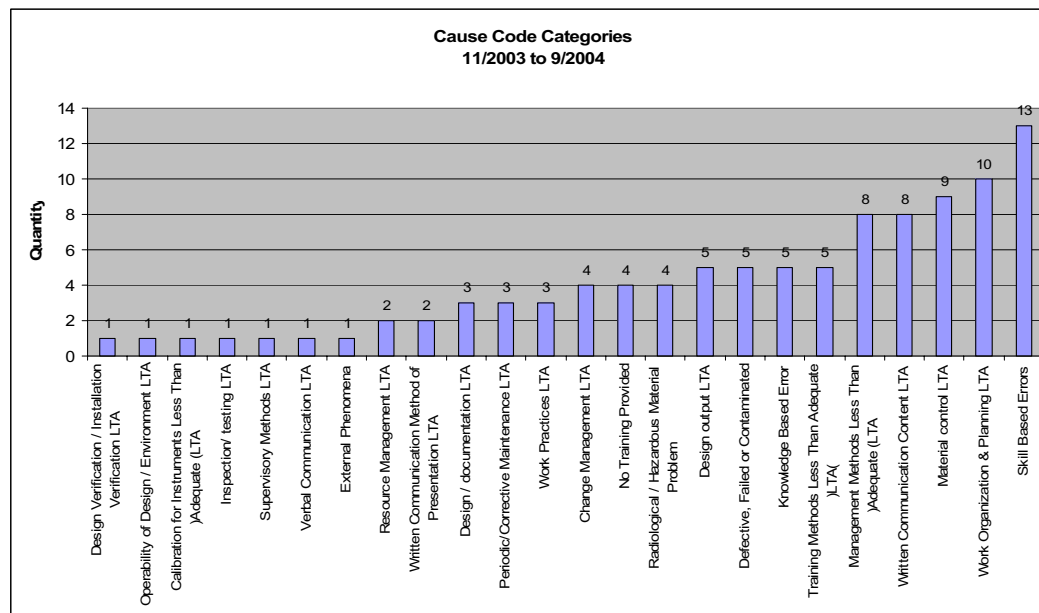


Figure IV.5: ORPS Occurrence Cause Codes

The following are definitions of the top five cause categories as defined by the DOE G231.1-2, Occurrence Reporting System Causal Analysis Guide:

1. Skill Based Errors – Inattention or over-attention to performance of work affected the event.
2. Work Organization and Planning LTA – Events associated with how the work to be performed was organized. This would include work scope, planning, assignment and scheduling of a task to be performed.
3. Material Control LTA – The event was due to the inadequate handling, storage, packing or shipping of material or equipment. The shelf life for material was exceeded. An unauthorized material or equipment substitution was made.
4. Written Communication Content LTA – Any written document used to perform work such as procedures, work orders, memos, standing orders, manuals, surveillance, etc.
5. Management Methods LTA – The processes used to control or direct work-related plant activities, including how manpower and material was allocated for a particular object.

2.5 Price-Anderson Amendments Act Reporting

During FY 2004, ORNL filed seven new Price-Anderson Amendments Act (P-AAA) Non-Compliance Tracking System (NTS) reports, as indicated in Table IV.3. This number was a significant reduction from FY 2003 reporting, primarily due the change in ORPS reporting thresholds and the corresponding changes in reporting guidance by the DOE Office of Enforcement.

Table IV.3. New P-AAA reports filed in FY 2004

Identification Mechanism	Internal Reports	Non-Compliance Tracking System Reports	Total
Self-Disclosing Events	7	5	12
Assessment Identified	6	2	8
Total	13	7	20

As shown in Figure IV.6, we also made progress in completion of corrective actions associated with NTS reports as evidenced through the total number of report closures. In addition to significant progress toward completion of existing actions, the Laboratory has enhanced efforts to assure the effectiveness of corrective actions through the implementation of expectations that all NTS actions will include a last action to perform a review of the completed corrective actions for their effectiveness. These follow-up effectiveness reviews are demonstrating the Laboratory's commitment to ensuring that deployed corrective actions are preventing recurrence of the original condition.

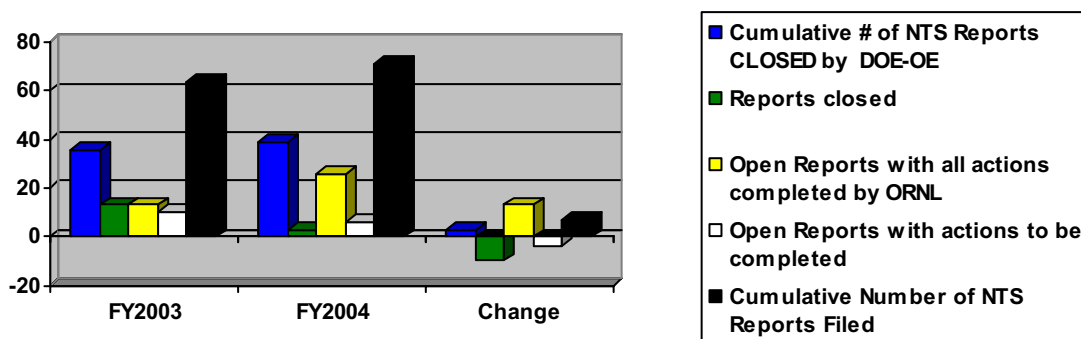


Figure IV.6: NTS Report Activity at ORNL

Successful completion of all actions by the respective issue owner is followed by the preparation of closure evidence packages for review by the DOE ORNL Site Office and the local DOE-ORO P-AAA Coordinator. The NTS closure process that we jointly pursue with DOE helps to ensure that effective corrective actions have been implemented to address the underlying root cause of the initiating issue. As indicated in Table IV.4 below, three NTS reports have been completely closed within the DOE NTS system during FY 2004. In addition, 26 NTS reports are currently classified as “all actions completed by ORNL” with six NTS reports having actions remaining to be completed.

Table IV.4. Status of NTS reports for FY 2004.

NTS Report Status	FY 2003	FY 2004	Change
Cumulative # of NTS Reports CLOSED by DOE-OE	36	38	+2
Reports closed	13	3	-10
Open Reports with all actions completed by ORNL	13	26	+13
Open Reports with actions to be completed	10	6	-4
Cumulative Number of NTS Reports Filed	64	71	+7

The data indicate that ORNL continues to identify issues requiring attention, reports them at an appropriate level, and develops appropriate corrective actions to address the root cause. In addition, the data points to a potential issue concerning final closure of NTS reports through DOE after completion of defined corrective actions by ORNL.

In FY 2004, a series of FY 2001–FY 2003 internal program self-assessments was followed by an ORNL-initiated review of the overall P-AAA Program by external subject matter experts. This overall program review was conducted in July 2004; then documented via our assessment program. The final report from this review indicated that no programmatic noncompliances were observed. This review added credence to the results of our previous three-year campaign of internal P-AAA reviews. The result of this independent review provided evidence of the maturation of line P-AAA program deployment, implementation, and process consistency across the Laboratory. In addition to this overall conclusion, several areas for improvement to enhance program excellence were identified and are being addressed through our internal tracking system.

In October 2003, a radiological event occurred in Building 2026 while ORNL personnel were conducting waste operations using manipulators to remotely denature, dilute, and dispose of LLLW in the Bethel Valley LLLW system. This event, when investigated by Laboratory management, revealed significant issues with regard to “work-arounds” for degraded physical plant systems and identified contributing issues with design, communication, work control, and human performance. A follow-up assessment of the event corrective actions, and a series of “extent of condition” reviews, were requested by Laboratory management to ensure that appropriate corrective actions were being taken and implemented. Separately, a DOE OE investigation of the event to determine if P-AAA noncompliances potentially existed was initiated by the DOE OE Director. The notification letter to ORNL identified the issues being investigated and the requirement to segregate unallowable investigation support costs. This investigation included an extensive document review request, an onsite investigation visit in June 2004, followed by an enforcement conference that was held September 30, 2004, at the DOE Office of Price-Anderson Enforcement facilities in Washington, D.C. As of the date of this report, a final determination of findings subsequent to the enforcement conference has not been made by DOE OE.

2.6 Operational Awareness Program

The goal of the Operational Awareness Program (OAP) is to drive process improvement by implementing a consistent Laboratory-wide process where potential hazards and less than optimum operational conditions are identified, documented and tracked in the Assessment Tracking System (ATS); corrective actions are verified to ensure effective implementation. Significant improvements were implemented during FY 2004 to strengthen the OAP program effort to ensure its value to Laboratory and organizational line management and staff.

The OAP provides an independent assessment of ORNL line organizations’ work spaces to ensure that potential hazards and less-than optimum operational conditions are identified and brought to the appropriate line manager’s attention. The OAP consists of a compliance and performance focus. Teams consist of a mix of ORNL senior management, DOE site representatives, and ORNL subject matter experts. This past year the following organizations were assessed through the OAP process:

- Chemical Sciences,
- Computer Science and Mathematics,
- Environmental Protection and Waste Services,
- Non-reactor Nuclear Facilities, and
- Quality Services.

A set of overarching issues were identified as a result of the OAP assessments performed this year. A summary of each follows.

- There is concern about the level of detail required in Work Plans and Research Safety Summaries. Some are written to cover several areas and activities making it difficult to determine the specific requirements and hazards associated with a specific work activity. Critical steps are not always addressed in work plans leading to a heavy reliance on individual staff knowledge and skills.
- Many stack ladders have signage stating that the ladder does not meet OSHA requirements and additional training is needed. This is standard signage for many stack ladders across the Laboratory. The additional training that is required varies based on facility, and according to some stack samplers, may only identify the noncompliance with OSHA requirements. There is a concern that this situation has become a “normalized deviation” and staff has accepted the associated safety risks for the past several years and continues to use the ladders in their current condition.
- Peeling paint from walls and ceilings was observed in many of the facilities. Paint peelings may contain PCBs and/or lead depending on the age of the paint. This is not only a housekeeping issue but a waste issue as well since proper disposal is necessary to ensure regulatory compliance. The handling and disposition of paint debris of unknown composition will greatly affect the costs and needs to be addressed by the Divisions and the Laboratory.
- Occupants of Building 4500S store flammable liquids in asbestos-lined cabinets/compartments beneath hoods. This practice has been allowed in the past due to the limited volume of flammables. Fire Protection Engineering (FPE) personnel have indicated that the built-in flammable storage cabinets that are located under the hoods in 4500S laboratories no longer meet fire codes. These cabinets are useful as ordinary cabinets, but are not flammable and combustible liquids storage cabinets. Small amounts (e.g., small aerosol containers or laboratory squeeze bottles) of flammable and combustible liquids may be in this type of cabinet in accordance with the guidance from the Fire Protection, Prevention, and Control subject area and the Chemical Safety subject area.

Emerging trends are:

- Improper storage and labeling of hazardous material and flammable liquids, and
- Inappropriate electrical safety practices.

These issues and trends are being identified to the appropriate Management System Owners for analysis and resolution.

3. SUMMARY OF FY 2004 AUDIT PROJECTS

The mission of Audit and Management Services is to assist the management of UT-Battelle, LLC, in effectively discharging its administrative, legal, and fiscal responsibilities in the management and operation of ORNL. To this end, Audit and Management Services performs independent and objective evaluations of the adequacy and effectiveness of management control systems and quality of performance. In FY 2004, we found that controls are generally in place and operating effectively to ensure that management’s objectives are achieved. Opportunities to enhance these controls were identified and management has implemented suggestions for improvement or action plans for implementation have been established. The following sections provide a summary of internal audit results for FY 2004.

3.1 Facilities Modernization (IA2004-1)

Purpose: Audit the facilities modernization program to ensure internal controls for the Institutional General Plant Project (IGPP) Program are adequate and operating effectively and determine whether funding sources for the new buildings and supporting infrastructure in the East Campus area were appropriate.

Results: In general, IGPP and Facilities Modernization management controls operated effectively to ensure IGPPs met DOE-approved criteria and the East Campus construction activities and infrastructure upgrades were funded appropriately. To enhance the project management process, management developed and implemented a performance management system to include closer monitoring of Facilities Management Division craft support effort.

3.2 Allowable Cost Review (IA2004-2)

Purpose: Audit of ORNL's transactions for allowability of costs to determine whether costs claimed for reimbursement from DOE during FY 2003 were allowable and in accordance with the terms and conditions of the prime contract.

Results: No questioned costs were identified for FY 2003 that required reimbursement to DOE; however, opportunities for enhanced controls in the time-entry and approval processes and the small-purchase credit card process were identified. Ongoing efforts to recover overpaid sales and excise taxes were noted. Management concurred with our suggestions for improvement and an action plan has been submitted.

3.3 Strategic Planning – Program Development (IA2004-3)

Purpose: Audit program development (PD) expenditures to determine whether management controls are in place and operating effectively to ensure these expenditures are appropriate

Results: In general, expenditures made from PD funds were appropriate. Controls could be further enhanced by: (1) improving guidance for PD expenditures and (2) determining the effectiveness of PD investments. Management concurred with our recommendations and an action plan has been submitted.

3.4 Foreign Visits and Assignments (IA2004-4)

Purpose: Audit the foreign visit and assignment process to determine whether management controls are in place and operating effectively to ensure that foreign visits and assignments are effectively managed, adequately controlled, and management's objectives are achieved.

Results: Generally, the Foreign National Office of the Laboratory Protection Division has sufficient management controls in place to provide reasonable assurance that foreign visits and assignments are managed in accordance with applicable requirements and in a manner consistent with management's objectives. Opportunities for improvement were identified in the areas of: (1) host responsibilities, (2) centralizing data, (3) processing foreign national construction workers, and (4) cyber security. Management concurred with our recommendations and an action plan has been submitted.

3.5 Prior Year's Audit Activities (IA2004-5)

This project is a yearly report to DOE of Audit and Management Services' prior-year activities. Through this process, follow-up actions for prior year audits are evaluated.

3.6 Administrative Controls – Nuclear Science and Technology Division (IA2004-6)

Purpose: Audit administrative controls in the Nuclear Science and Technology Division (NSTD) to determine whether administrative procedures and management controls in NSTD are in accordance with UT-Battelle, LLC, policies and procedures.

Results: In general, most areas reviewed have sufficient administrative procedures and management controls in place to provide reasonable assurance that company goals and objectives are met and assets are properly utilized and safeguarded. NSTD could take additional steps to enhance management controls in the areas of small-purchase credit cards, export controls, training, and human resources. In addition, other Laboratory-wide steps could be taken to enhance management controls in the areas of cost transfers and human resources. Management concurred with our suggestions for improvement and an action plan has been submitted.

3.7 Recovery Audit Program (IA2004-8)

Purpose: Audit the audit recovery program to identify any amounts recovered during FY 2003 and any additional overpayments.

Results: Overpayments totaling \$156,684 were previously reported to the DOE during FY 2003 as part of the audit recovery program. However, \$5,689 was subsequently identified as returned goods and not erroneous payments. The remaining \$150,995 mostly related to duplicate posting of invoices that have been recovered or reversed. Further, discounts totaling \$6,469 were not taken during FY 2003, generally due to invoices being posted after the discount period. Additional overpayments were not noted. Management has taken action to strengthen controls by monitoring system reports on a more frequent basis.

3.8 Sole Source Selection and Time and Materials Subcontracting (IA2004-9)

Purpose: Audit of (1) controls for selecting sole source vendors and (2) the time and materials subcontracting process to determine whether management controls are in place to provide reasonable assurance that these activities are effectively managed, adequately controlled, and management's objectives are achieved.

Results: In general, most areas reviewed have sufficient controls in place to provide reasonable assurance that company goals and objectives are met and assets are properly utilized and safeguarded. Additional steps can be taken to enhance controls to ensure the accuracy of SAP coding of vendor selection methods and enhance controls in the payment of certain invoices; potential efficiencies could also be achieved in the identification of government property. Further, a noteworthy initiative that increases controls in the purchasing process was noted. Management concurred with our suggestions for improvement and will submit an action plan.

3.9 SNS Architect Engineer/Construction Management Subcontract Administration (IA2004-10)

Purpose: Audit of the Spallation Neutron Source architect engineer/construction management (AE/CM) subcontract administration to determine whether management controls are adequate to ensure applicable requirements are met and management's objectives are achieved.

Results: In general, most AE/CM subcontract administration areas reviewed have sufficient administrative procedures and management controls in place to provide reasonable assurance that company goals and objectives are met. Opportunities for improvement were identified in the areas of (1) subcontract records management, (2) warranty management, and (3) subcontractor-held property management. Additional review is being conducted to determine whether further actions should be taken to obtain preaward audits or waivers. Management generally concurred with the suggestions for improvement and will submit an action plan.

3.10 Nuclear Materials Control and Accountability (IA2004-11)

Purpose: Audit of nuclear materials control and accountability to determine whether management controls are in place and operating effectively to ensure that nuclear materials are managed in accordance with applicable requirements and in a manner to ensure management's objectives are achieved.

Results: Management plans to enhance controls related to NMC&A Department assessments of divisions providing analytical nuclear material measurement services. Management has additional opportunities to enhance controls by emphasizing timely notification of nuclear material discrepancies as well as due diligence in the determination of the causes of discrepancies. Management concurred with our suggestions for improvement and submitted an action plan.

3.11 Accelerated Vendor Inventory Delivery Plus System (IA2004-12)

Purpose: Audit the Accelerated Vendor Inventory Delivery (AVID) Plus system to determine whether controls are in place and operating effectively to ensure that the system is managed in accordance with applicable requirements and in a manner to ensure management's objectives are achieved.

Results: AVID Plus system controls are generally operating effectively to achieve management's objectives. Actions could be taken to enhance controls over suspect/counterfeit items and defective items, and additional actions could be taken to increase efficiencies by including certain non-catalog items in the AVID Plus catalog. Management concurred with our suggestions for improvement and will submit an action plan.

4. SUMMARY OF FY 2004 OVERSIGHT AND ASSESSMENT SERVICES

The Oversight and Assessment Services (O&AS) organization is the functional element of PBMS charged with providing additional assurance to UT-Battelle and ORNL leadership, and to DOE, that the Laboratory's performance assessment and assurance processes are effectively and efficiently providing information to support critical management decisions.

Overall the assessment results were utilized to prepare the Laboratory for upcoming accreditations/external audits, provide a verification of the status and effectiveness of corrective actions, and identify programmatic issues to the responsible line management. A high degree of correlation was

found between level of management engagement/involvement and positive trends in the assessment results.

The following sections provide a summary of the specific O&AS assessment results and feedback gained in FY 2004.

4.1 Performance Assessment Evaluations (IO-2004-06, IO-2004-07, IO-2004-09, IO-2004-15, IO-2004-17, IO-2004-19, IO-2004-22, IO-2004-23, IO-2004-24)

Purpose: To conduct a series of assessments that satisfies a Performance Evaluation Plan (PEP) commitment for an independent evaluation of the state of maturity of ORNL's performance assessment program.

Results: The results of these assessments are described in Part I, Section 2.2.3, and in Part V of this report.

4.2 HFIR Corrective Action Plan Status (IO-2004-13)

O&AS conducted an assessment to determine if actions taken in response to the March 2003 HFIR Corrective Action Plan have been successful in correcting the identified weaknesses. The results of this assessment demonstrated that the substantial efforts of line and senior laboratory management, as well as HFIR staff, have resulted in clear and measurable improvement in HFIR operations. Although considerable improvement was noted, continued management and staff attention and effort will be required to continue the positive trend.

4.3 Evaluation of Quality Services Division Operational Effectiveness (IO-2004-01)

At the request of the Quality Services Division Director, O&AS conducted an evaluation of the functionality and operational effectiveness of the organization. This review was conducted against a series of overarching principles addressing the areas of mission definition, expectations/roles and responsibilities, business/operational planning, organization functionality, operating practices, human resources, and performance assessment and process improvement. A number of critical observations resulted from this review; no consistent, well understood vision of the Division among the staff existed, there was not a Division-specific business plan, and the use of tools and processes to trend key Division performance indicators was limited. A number of recommendations were identified for the Division to consider, with emphasis on establishing a Division mission that is clearly linked to the laboratory agenda and critical outcomes, and is understood by both QSD staff and customers.

4.4 Independent Verification of the Effectiveness of the Corrective Actions Associated with NTS-ORO-ORNL-X10REDC-2001-0001 (IO-2004-02)

O&AS led a multidisciplinary team to determine if there was evidence that a configuration management program was formal, effective, and implemented per Building 7920/7930 Safety Basis documentation. This review was the final action necessary to close-out the noncompliance report. Based on the team's observations, it was determined that there existed a configuration management program and it was being implemented, but the program was still maturing and would need to be reviewed periodically to ensure that it continues to evolve.

4.5 Evaluation of Quality of Maintenance Work Packages at HFIR (IO-2004-03)

This evaluation was conducted to satisfy a commitment set forth in Corrective Action 8.4, “Perform an independent assessment of the quality of MWP’s” of the Corrective Action Plan for the High Flux Isotope Reactor, March 2003. Overall, there was improvement in the quality of the MWP’s and the staff was committed to making HFIR successful. However, additional improvements in processes for MWP development and in the rigor of applying these processes to the preparation and execution were identified.

4.6 Comparison of SBMS Performance Assessment Requirements and IO Performance Effectiveness Evaluation Observations (IO-2004-04)

Forty-two individual requirements for Performance Assessment were identified in the ORNL SBMS. Analysis of the results of Oversight and Assessment Services efforts to evaluate the effectiveness of the line organization performance assessment programs (conducted from FY 2001–FY 2004) indicated that twenty-eight SBMS requirements are either not being consistently met or are only partially being met. Generally, problematic areas included: the role of various functional experts (Quality Managers, Quality Assessment Specialists, Performance Assessment Coordinators, etc.) in performance assessment, development of an approach to the performance assessment process and plan, analysis and trending of performance assessment data, and communication of performance assessment results.

4.7 Review of Management Actions and Communications in Response to Liquid Spill at Building 2026 (IO-2004-05)

O&AS was tasked to observe line management’s response to the liquid waste spill event at Building 2026 on October 6, 2003. The results of this review are controlled as “UT-Battelle Business Personal,” because of the discussion of personnel management issues. In summary, however, the review concluded this event involved several organizations and the initial attempt to share responsibility for the review was not effective.

4.8 ORNL’s Evaluation of Environmental Management System per ISO 14001

An evaluation of the UT-Battelle Oak Ridge National Laboratory (ORNL) Environmental Management System (EMS) was conducted to determine if the program conformed to the ISO 14001 Standard, Environmental Management Systems—Specification with guidance for use (1996 version); and to evaluate corrective actions associated with the previous EMS assessment (completed in August 2003.) A team of three qualified, independent auditors from Pacific Northwest National Laboratory and ORNL, under the auspices of the ORNL Oversight and Assessment Services organization, audited the design, implementation, maintenance, and effectiveness of the UT-Battelle EMS against all requirements in these clauses. The audit indicated that six elements met at least the minimum ISO 14001 requirements. However, the UT-Battelle EMS did not fully conform to the ISO 14001 model for the remaining eleven elements. In addition, 21 noteworthy practices were identified associated with 12 elements.

4.9 Evaluation of the USQD Process (IO-2004-14)

O&AS conducted a focus evaluation of the Unreviewed Safety Question (USQ) process to determine how well the process implemented at ORNL conformed to the requirements of 10 CFR Part 830.203, “Unreviewed Safety Question Process,” and the associated “Implementation Guide for Use in Addressing

Unreviewed Safety Question Requirements,” DOE G-424.1-1. Results indicated that the framework for implementing the USQ process appeared to be in compliance with the requirements of 10 CFR 830.203. However, the logical rigor used in answering the USQ questions could be enhanced, additional formality in the use of the REDC Categorical Exclusion was needed, and an opportunity exists for the USQ process to be periodically reviewed by the line as part of their self-assessment program.

4.10 OA-50 Preparation Laboratory – Corrective Action Effectiveness Review (IO-2004-18)

In response to a request from the Operational Safety Services Division, O&AS conducted a review to perform an analysis of selected assessment findings and corrective actions to assess the effectiveness of ORNL self-assessment activities in driving improvement. Overall, the evaluation found that the majority of the Assessment Tracking System action entries examined provided adequate rationale and documentation of closure for the conditions reviewed. However, a wide variability in the level of corrective action closeout rigor and documentation rigor was observed, some schedules for corrective action implementation were excessively long, and future commitments for planned follow-up effectiveness assessments were not generally included in the corrective action plans.

4.11 White Paper on the Status of RRD/HFIR Self-Assessment Program (IO-2004-21)

As documented in the March 5, 2003, HFIR Corrective Action Plan, O&AS was responsible for reviewing the RRD self-assessment program by August 15 of each year “until sufficient program maturity is deemed to have been achieved by senior management.” It was determined that the Physical Sciences Director and the RRD management team are fully committed to the performance management approach. In regard to deployment and process improvement, it was concluded that further study is needed at a later date to verify that the preliminary evidence observed in this review was real and sustainable.

4.12 Evaluation of Work/Project Planning and Control for Operations, Maintenance, and Services (IO-2004-11)

O&AS reviewed the effectiveness of the implementation of the procedure “*Work Control for Operations, Maintenance, and Services*” with regard to the principles of Integrated Safety Management in planning and executing OM&S activities. Results indicated that the safety accountability and culture have improved across the work activities and organizations and that the SBMS-based work processes have penetrated the work force. However, additional clarity in the grading of work activities and improvements in the consistency of work planning processes were identified.

4.13 Spallation Neutron Source Project Price-Anderson Amendments Act Procurement Process (IO-2004-08)

O&AS performed a review of the implementation and effectiveness of the Price-Anderson Amendments Act (P-AAA) procurement process utilized by the SNS Project, specifically the applicability of P-AAA requirements to any specific procurement action and how these requirements were flowed down to vendors and contractors, was evaluated. The review concluded that the SNS Project procurement system was well defined and provided the appropriate level of controls to ensure that P-AAA requirements were captured and communicated. Enhancements to staff training regarding which activities or components have P-AAA requirements, the flow down of P-AAA requirements into technical specifications, and the completeness of the procurement packages would lead to a stronger program.

4.14 Evaluation of Communications at HFIR

The Director of Independent Oversight was tasked to conduct an independent assessment of communications at the High Flux Isotope Reactor as a result of the management review conducted in early 2003, which revealed multiple communication breakdowns as contributing factors. The results of this review are controlled as “UT-Battelle Business Personal,” because of the discussion of sensitive personnel management issues. In summary, however, the review concluded that there are signs that communications at all levels improved, but there is still work to be done and management needs to continue their efforts.

4.15 Evaluation of Acquisition Management (IO-2004-10)

O&AS was tasked through the NTS report ORO-ORNL-X10BOPLANT-2003-0001 to perform an “in-progress check” of system maturity with regard to acquisition management. This review was part of the evaluation of Work/Project Planning and Control for OM&S. The Laboratory-level documentation associated with the Acquisition Management System appeared to be well written, easy to follow, and included many exhibits to aid the reader. Based on a limited review of the processes implemented by organizations using the OM&S work control system, there was little consistency with regard to the requestor, technical specifications used, and the documentation associated with procurements.

4.16 Effectiveness Review of Corrective Action Taken in Response to the October 6, 2003 Radiological Spill/Uptake Event at Building 2026 (IO-2004-12)

O&AS facilitated a review of the rigor, quality, timeliness, and effectiveness of the corrective actions in response to the Building 2026 event and areas of related concern. This review was specifically charged with evaluating corrective actions established to address the fourteen “judgments of need” identified in the *Report of the Investigating Team for the October 6, 2003, Radiological Event at Building 2026*. Summary conclusions related to progress and schedule adherence, timeliness of corrective action due dates, technical accuracy of the actions, and both positive and negative impacts related to the technical accuracy of the identified corrective actions were developed.

Conclusions were as follows:

- Building 2026 and other nuclear facility cleanout efforts received higher priority,
- Some modest working-level improvements were observed in radiological control practices and work-control practices,
- Committed actions were being completed on time, however, some important near-term actions were potentially at risk,
- The corrective action development and the dates associated with these actions was judged to be not timely,
- Lack of an extended condition review beyond the NNFD,
- Compensatory measures were not implemented for several conditions, and
- Several actions did not use the appropriate owners or management tools to achieve the desired outcomes.

4.17 Laboratory Space Safety Compliance (IO-2004-16)

In response to a request from the Operational Safety Services Division, O&AS conducted a compliance evaluation of safety management and implementation in selected laboratory spaces. The evaluation focused on working-level compliance with regards to: hazard identification and hazard control implementation, personnel understanding and implementation of the responsibilities assigned to them, and compliance with applicable SBMS requirements in laboratory spaces and work.

Overall, the Laboratory Space Managers and line management demonstrated a strong sense of ownership and a responsibility for safety. Laboratory personnel were knowledgeable of hazards and controls and generally recognized their responsibility for safety. However, excessive chemicals were found in potentially non-complaint management condition, numerous instances of hot surface thermal hazards were not marked or guarded, and the LSM functionality had not been adequately documented into Laboratory Standard Operating Procedures, Facility Use Agreements, and the work control processes.

4.18 Hoisting and Rigging Program Review (IO-2004-20)

O&AS conducted an assessment to provide UT-Battelle management with an overview of the ORNL hoisting and rigging program and how it measures against the “DOE Standard Hoisting and Rigging, DOE-STD-1090-2004.” This assessment found that the Laboratory had an established hoisting and rigging program, there was a strong sense of commitment to safety among the staff involved with hoisting and rigging activities, and the observed lifting activities were performed safely. However, the assessment identified several opportunities for improvement in procurement, inspection, ownership, procedures, and training that would strengthen the program. In addition, the following areas were identified that did not meet the requirements of the DOE Standard: lack of sling identification, incomplete documentation of monthly inspections, noncompliant below-the-hook devices, and outdated training.

5. EXTERNAL ASSESSMENTS

As shown in Table IV.5 and Figure IV.7, ORNL undergoes reviews and evaluations by a number of external regulators, including the State of Tennessee, DOE, and other federal government agencies. The results of each assessment are reviewed, analyzed (including the development of corrective actions), and recorded, as appropriate, in the ORNL Assessment Tracking System. There were no systematic failures identified by the external assessments conducted; only opportunities for improvement, which is to be expected for maturing programs.

Table IV.5. GAO External Oversight Activities at ORNL in FY 2004

Activity	Month	Person-days of effort
Review of Nonproliferation	December 2003	2
Review of Public Private Partnerships and Energy Savings Performance Contracts	February 2004	3
SAP Review	February 2004	0
Review of EEO Issues at DOE National Laboratories	April 2004	6

FY 2004 Major External Assessment Efforts at ORNL

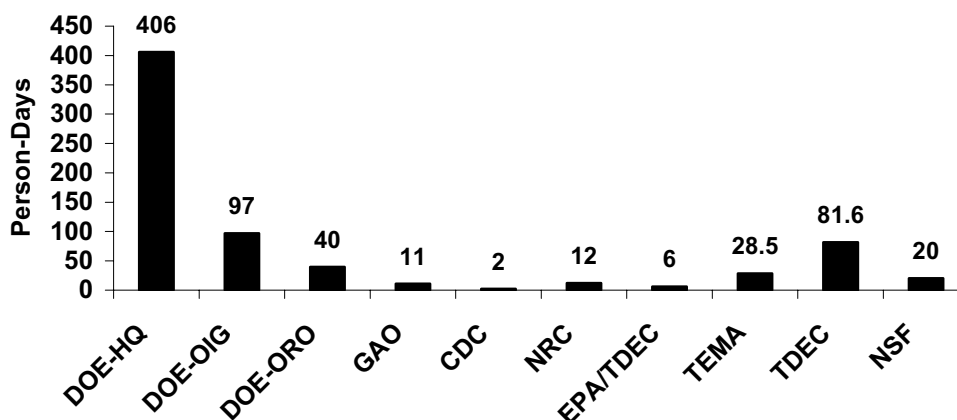


Figure IV.7. Major external assessments at ORNL in FY 2004.
(DOE-ORO: DOE's Oak Ridge Operations Office. DOE-OIG: DOE Office of the Inspector General. DOE-HQ: DOE Headquarters. TDEC/EPA: Tennessee Department of Environment and Conservation/Environmental Protection Agency. NRC: National Research Council. TEMA: Tennessee Emergency Management Administration. CDC: Center for Disease Control. NSF: National Sanitation Foundation)

The number of individual DOE oversight reviews increased from 20 in FY 2003 to 25 in FY 2004, and the number of person-days associated with these reviews increased from 383.5 to 555. We continue to actively partner with DOE in the conduct of internal independent evaluations of organizational performance assessment (see Part I, Sect. 2.2.3 of this report).

In FY 2004, The Environmental Protection Waste Services Division successfully completed two major external assessments; the Audit of the UT-Battelle Oak Ridge National Laboratory for the Waste Acceptance Criteria at the Nevada Test Site and the ISO 14001 Registration Audit.

5.1 Non-DOE External Oversight Activities

Four auditors from the National Sanitation Foundation (NSF), an independent body from the International Organization for Standards, reviewed the design and implementation of ORNL's Environmental Management System for conformance to the ISO 14001 environmental systems standard during the week of July 12. The auditors recorded only three minor findings and recommended ORNL for ISO 14001 registration. Registration to the ISO 14001 standard clearly demonstrates to our stakeholders our commitment to environmental and operational leadership. ORNL joins Brookhaven and Pacific Northwest as Battelle-managed Laboratories that are registered to ISO 14001 standard.

5.2 DOE External Oversight Activities

During FY 2004, two DOE Facility Representative Surveillance Reports were transmitted to ORNL; these reports included one concern, eight findings, three observations, and one strength. ORNL evaluated

each of the concerns and findings and has documented appropriate corrective action to address each of them.

As indicated in Table IV.6, DOE conducted 25 external assessments of ORNL in FY 2004. These activities required 555 person-days of on-site effort (in addition to the regular oversight provided by the DOE ORNL Site Office staff assigned to the Laboratory).

The majority of effort was dedicated to the ORNL ES&H Inspection conducted by the Office of Independent Oversight and Performance Assurance (OA-40). The final report revealed a number of positive attributes in relation to implementation of Integrated Safety Management policies. The assessment team found significant improvement in all areas reviewed including the development of structured oversight and work control processes, implementation of the Standards-Based Management System, and strengthening the management of nuclear facilities. In addition, the framework for integrating safety into work activities has been established and improvements in safety culture are evident.

The assessment determined that continued effort is needed to address some gaps in the work control processes, strengthen implementation of processes for analyzing hazards, specifying controls, and conduct of feedback and improvement activities. Several analyses supporting the High Flux Isotope Reactor Safety Analysis Report were missing or incomplete and require further evaluation.

Table IV.6. DOE external oversight activities at ORNL in FY 2004

Activity	Month	Person-days of effort
DOE Office of Basic Energy Science: Peer Review of HFIR and Neutron Scattering Facilities	October	36
DOE-OIG: Oak Ridge Complex Radio Conversion Project	October	0
DOE-HQ Office of Environmental Management: DOE Continuing Qualification Audit of RMAL	November	10
DOE Office of Science: Property Review	November	10
DOE-OIG: Audit of DOE's Controls Over Contractor Educational Credentials	December	0
DOE-OIG: Biosecurity of Selected NNSA/DOE Sites	December	3
DOE-NE: NE Assist	February	16
DOE-OIG: Retention and Management of the Department's Legacy Information	February	0
DOE-OIG: Annual Audit of the GMRA Portion of the Financial Statement Audit and the Evaluation of DOE's Unclassified Information System	March	10
DOE-OIG: Assessment of Changes to the Internal Control Structure and Their Impact on the Allowability of Costs Claimed by and Reimbursed to UT-Battelle, LLC for FY 2003	March	1
DOE-OIG: IG Inspection of Chronic Beryllium Disease Prevention Program	March	3
DOE-OIG: Audit of Controls over Reimbursement of Educational Expenses	March	3.5
DOE-Office of Security and Safety/DOE Office of Science: SSA Assistance	April	23.5
DOE-(OA-40): ORNL ES&H Inspection (OA-40)	April	300
DOE-OIG: Inspection of Security Access Control at Selected DOE Sites	April	0.5
DOE ORO Fleet Management: ORNL Fleet Management Review	April	0.5
DOE ORO: Criticality Safety Assessment	April	16.5
DOE NVO: Audit of the UT-Battelle Oak Ridge National Laboratory; Oak Ridge, TN; Audit No. RWAP-A-04-10	April	12
DOELAP: DOELAP On-Site Assessment of the ORNL Internal Dosimetry Program	May	5
DOE-HQ: OCRWM Office of QA Supplier Survey	June	4
DOE-OE: 2026 Investigation	June	6.5
DOE-OIG: Audit of DOE's Implementation of I-Manage Stars Project	July	12
DOE-OIG: KPMG Audit of National Isotope Program and Preparation of Audited Financial Statements	July	61
DOE ORO: Technology Partnering and CRADA Program Appraisal	August	18
DOE-OIG: IG Inspection-Safety and Security Contractual Flow Down at ORNL and other selected sites	September	3

PART V: MATURITY OF PERFORMANCE PLANNING AND SELF-ASSESSMENT PROGRAMS

1. PROGRAM SUMMARY

UT-Battelle uses a Performance-Based Management System (PBMS) to guide its approach to business planning and assessment at ORNL. Organizations at all levels use PBMS to measure their performance against the Laboratory Agenda and the goals and commitments that support it. PBMS also provides ORNL staff and management with the results of self-assessment activities conducted at the directorate, division, group, and individual performance levels. The information gained from these self-assessments is crucial in defining our successes, areas for improvement, and future business planning strategies.

PBMS incorporates the “balanced scorecard” approach as an internal self-assessment structure for effectively identifying the most important operating factors for our wide range of business units, sponsors, missions, and goals. This approach provides five overarching categories — customer focus, business/financial performance, organizational effectiveness, staff and leadership, and compliance—for use in developing strategic plans and business plans and in formulating self-assessment plans.

The self-assessment requirements of PBMS are deployed throughout the Laboratory to institute a more rigorous and thorough approach to the business planning and assessment processes. A complementary action to instill additional rigor was the deployment of the Assessment Tracking System (ATS) to replace the Laboratory Issues Database System and the Nonconformance Tracking System. Management intent is to provide all organizations with a single tool for planning, tracking, and analyzing the results of assessment activities.

This tool has enhanced our ability to meet management expectations for institutionalizing and optimizing the assessment planning and management process on a site-wide basis. ATS has enabled us to make self-assessment, as a component of PBMS, a key function to ensure that we have full knowledge of our strengths and improvement targets, both for our commitments to the Department of Energy (DOE) and for our individual business units.

2. RESULTS OF ORGANIZATIONAL SELF-ASSESSMENT ACTIVITIES

Self-assessment plans are comprised of two parts: self-assessment approach documents and self-assessment schedules. All directorates and divisions developed and implemented self-assessment planning documents this year. Some organizations have chosen to establish their overarching self-assessment approach documents at the directorate level while requiring their constituent divisions to provide lower level-planning inputs and schedules as components of the over-all directorate plan. Other directorates have established approach documents and schedules at both the directorate and division levels. This flexibility is necessary to ensure that each organization has a self-assessment function that best suits its needs.

A Laboratory-level view of the comprehensive effort represented by these plans indicates that literally hundreds of self-assessing activities were performed by ORNL organizations this year. From a systems perspective, positive trends in how we are using our assessment resources can be discerned.

During FY 2004, the Oversight and Assessment Services organization continued a multiyear series of evaluations to gauge the maturity of ORNL line organizations’ implementation of the performance

assessment element of the PBMS. Six ORNL divisions (Chemical Sciences, Condensed Matter Sciences, Craft Resources, Facilities Development, Nonreactor Nuclear Facilities, and Nuclear Science and Technology) and three ORNL directorates (Audit and Assessment Services, ESH&Q, and Physical Sciences) were evaluated. The results provide insights that will assist the performance assessment process as the mechanism used to drive continuing improvement.

The composite FY 2004 rating of 3.01 (out of a possible four points) resulting from the O&AS reviews is encouraging. This score represents the highest rating attained in the first four years in which these evaluations have been conducted, and it compares favorably with the rating of 2.9 in FY 2003. The range of scores for this year, 2.2 to 3.6, indicates that there is still opportunity for improvement in developing a more consistent understanding and implementation of PBMS processes and tools.

General strengths of the performance assessment process are the demonstrated ownership and effectiveness of the line management with regards to all aspects of performance assessment. This was evident at all management levels. General areas that need improvement are the prioritization of the assessment activities and the application of the assessment results to drive improvement.

The following results identify specific line organization strengths and areas for improvement defined through the O&AS evaluations in the areas of approach, deployment, and process improvement.

Approach: Strengths and Areas for Improvement

- + The line management's ownership of the performance assessment process is well understood and documented through their R2A2s.
- + Many organizations have engaged an assessment coordinator who has assisted the organization with the development, implementation, and coordination of performance activities.
- Additional communication efforts are necessary to ensure that staff at all levels understand their roles in the performance assessment process.

Deployment: Strengths and Areas for Improvement

- + Organizations have become more creative in tailoring the assessment activities to the functions being evaluated.
- Assessment activities are numerous and need to be prioritized to ensure that the organization is receiving the maximum benefit from its performance assessment program.

Process Improvement: Strengths and Areas for Improvement

- + Customer feedback is being solicited in various methods and is tailored to each customer.
- Results from the performance assessment activities are not always analyzed to look for trends, determine root cause, or application to other organizations.

3. MANAGEMENT SYSTEM MATURITY EVALUATION RESULTS

As the gatekeeper system for translating laws, orders, and regulatory requirements into Laboratory-wide documents, SBMS functions to ensure that program descriptions, subject areas, and procedures are current, accurate, and relevant to the activities performed by ORNL staff. During FY 2004, a maturity evaluation process was formalized in SBMS as a structured, comprehensive approach to measure the efficiency, effectiveness, and deployment of management systems at ORNL.

Maturity evaluations are conducted on a two-tier basis. The maturity evaluation process is used by Management Systems Owners on an annual basis to conduct internal evaluations against the criteria

established by SBMS in the focus areas of management system design, application, assessment and feedback, and planning and the ability to react to change. In addition to the internal reviews, external peer reviews of nine management systems were conducted using the same criteria. Peer review teams were composed of personnel independent of the management system and representing research and development, operations, and support constituencies.

A defined set of strengths and areas for improvement emerged as a result of the conduct of management system maturity evaluations. The results obtained during FY 2004 will serve as the foundation for future maturity evaluation efforts.

The following strengths were discerned as maturity evaluation results were compiled:

- With very few exceptions, most components (program descriptions, subject areas, and procedures) are in place, current, and functioning as intended. The maturity evaluation process requires a thorough review of all management system documents.
- Strong efforts were made by management systems (and ensured by SBMS) to include the widest possible cross section of stakeholders in the maturity evaluation process. This diversity of background from across the Laboratory ensured that the process resulted in candid and useful feedback.
- Roles, responsibilities, authorities, and accountabilities (R2A2s) needed to support management systems are, for the most part, in place.
- All management systems that underwent the maturity evaluation process displayed a sincere intent to identify problems and make improvements. A consistent intent to explore opportunities for improvement was evident.

Consistent areas for improvement also emerged among management systems:

- Business planning, resource prioritization and allocation, goal setting, and performance assessment activities based on the management system concept are, in most cases, at an early stage of development. Business planning for management systems is still closely tied to the line organization that owns the management system.
- More graphical guidance (e.g., flowcharts, maps) is needed to help users understand the linkage within and among management system components and processes. Many reviewers indicated that they find the SBMS system difficult to effectively navigate and that graphical guidance depicting the hierarchy of program descriptions, subject areas, procedures, and exhibits would be helpful in finding needed documents in a timely way.
- Regular communication with staff needs continuing attention to ensure a clear understanding of management system processes, changes and improvements. An SBMS subscription service is available, but few staff take advantage of it. Communication with staff about individual management system updates is highly variable. The effectiveness of the roll-out of a new or altered subject area or procedure directly impacts the staff's understanding and adoption of new requirements.
- Most management systems agreed that more effective means to gain customer feedback are needed. Some management systems have begun utilizing customer feedback mechanisms, but most feel that their efforts so far are – at best – rudimentary and require improvement.
- Identifying meaningful metrics that provide evidence that management systems are effectively supporting the Laboratory's agenda, missions, and goals was cited as an improvement area by the majority of management systems.

4. SUMMARY OF SELF-ASSESSMENT MATURITY INDICATORS

Several positive trends have converged to provide management with key information on our organizations' buy in and use of the performance assessment function as a business process.

- There is consistent evidence of participation by management personnel in the planning and conduct of assessment activities down to the Level 3 (group leader) management position. Some organizations have progressed further by clearly defining staff-level assessment responsibilities as well. Evidence of the use of internal R2A2s to convey performance assessment expectations was observed.
- The majority of organizations have developed a consistent understanding of the connection of their organizational assessment activities to the Laboratory Agenda, the Performance Evaluation Plan, and their organizational business/strategic plans. Associated with this indicator, organizations have become more adept at developing performance indicators and metrics that are closely related to their mission and goals.
- Line organizations are developing performance assessment programs that include measures of performance for support systems and organizations that may affect the effectiveness of their activities and operations.
- Assessment results are being increasingly used to identify improvement areas, institute needed changes, and optimize organizational performance. The concept of utilizing performance assessment results as inputs to future business planning activities is well-understood as evidenced by anecdotal information and organizational business/strategic plans and performance assessment plans.

4.1 Strengths

- PBMS provides the basis for consistent flow down of goals and commitments from the Laboratory Agenda to the Laboratory's annual Performance Evaluation Plan and organizational self-assessment plans. Evidence provided by some line organizations indicates that it also has the potential to be used for individual performance assessments and development plans.
- There is an extensive amount of information and guidance concerning performance assessment in the PBMS Description including the establishment of the Assessment Coordinator position to facilitate implementation of performance assessment processes.
- Strong, consistent management endorsement and knowledge of performance assessment as a function of business planning are evident. Organizations are dedicating significant resources – both time and personnel – to develop the effectiveness of their performance assessment programs. This was clearly evident in both line and support organizations throughout the Laboratory.

4.2 Areas for Improvement

- PBMS must establish a mechanism to ensure access to, and review of, all Laboratory line organization performance assessment plans. PBMS must also develop a consistent and timely method for obtaining performance assessment information from line organizations. These results would be highly beneficial to the Laboratory as precursor information to discern site-wide trends in possible future problem areas and preclude significant impacts.
- PBMS must enhance consistent line organization support through mentoring and guidance by Assessment Coordinators and quality assurance personnel. Clear R2A2s concerning performance assessment activities must be established to ensure a basic understanding of the performance assessment support function. Other needed enhancements include the establishment of training for Assessment Coordinators and the development of an Assessment Coordinators' forum or users group

for the exchange of performance assessment implementation information among ORNL organizations. This information exchange would also provide the PBMS with a customer feedback function to determine where line organizations need increased management system assistance in making performance assessment more effective.

- Enhancement of the Assessment Tracking System's (ATS) utility and a clear understanding of the system and its appropriate usage among line organizations is necessary if it is to achieve its potential, including the effective tracking and closure of corrective actions, compilation and communication of assessment results, and information analysis. This enhancement must include establishing clear ATS-related requirements within the Performance Planning and Assessment subject area.

In summary, strengths and clear areas for improvement have been identified this year and are being used in our FY 2005 management systems planning activities to define our business priorities. Continuing progress in the understanding and use of PBMS processes and tools by line organizations is evident, but more work is needed to reach our goals in helping our customers plan their assessments, document their assessment methods and results, and perform useful information analysis for application to their next business planning cycle. Assessment of our management system - based both on multiple evaluations and management and staff feedback concerning our current efforts - tells us that we have much work to do in ensuring that PBMS becomes the business performance measurement and feedback mechanism it is intended to be. We will continue to make use of the periodic, knowledgeable evaluative function provided by O&AS to ensure that we are in tune to the current state of PBMS deployment and implementation. The maturity of our management system will continue to grow as the results associated with our processes and tools become increasingly useful to management and staff as high-value inputs to future business planning and informed management decision-making.

PART VI: SUMMARY AND CONCLUSIONS

This section of the self-evaluation report summarizes the key strengths and areas for improvement that were identified at Oak Ridge National Laboratory during FY 2004 through the execution of our Performance-Based Management System (PBMS) and represents a distillation of the analyses contained in this report. UT-Battelle has made a philosophical commitment to a balanced management approach that we believe leads to simultaneous excellence in the areas of science and technology (S&T); Laboratory operations and environment, safety, and health (ES&H); and community service. UT-Battelle also takes seriously the idea of continuous improvement. By partnering with our customers and stakeholders and learning from our own assessments, we identify organizational strengths and areas for improvement that form a basis for driving continuous improvement.

1. KEY LABORATORY STRENGTHS

1.1 Science and Technology

This section does not include information from surveys of our principal Department of Energy (DOE) customers for S&T.

1.1.1 Laboratory-Wide S&T Achievements

In addition to outstanding performance in support of our commitments contained in the Performance Evaluation Plan, other indicators highlight the breadth of our accomplishments in science and technology:

- Successfully competed for the opportunity to build the National Leadership Computing Facility, which will deliver ultrascale computing capability for scientific research and revitalize the U.S. effort in high-end computing;
- Partnered with the Princeton Plasma Physics Laboratory to develop the winning proposal to host the U.S. ITER Project Office, supporting the top-priority project in DOE's 20-year facilities plan;
- Set a new world record for high-resolution microscopy, using an aberration-corrected electron microscope to deliver a direct image of silicon atoms with a resolution of 0.6 Å; and
- Earned recognition for Laboratory accomplishments with three awards in the R&D 100 competition, four awards from the Federal Laboratory Consortium for Technology Transfer (the maximum number allowed for a single organization), and the election of a senior ORNL researcher to the National Academy of Engineering.

These accomplishments are only a few of the examples that illustrate the results of fostering a Laboratory culture that encourages our staff not only to meet our yearly commitments, but to go beyond them in pursuit of new scientific and technological capabilities and achievements.

1.1.2 Laboratory Space Manager Initiative

During FY 2004, the procedure entitled "Maintaining ISM in Laboratory Space" was issued under the Work Control subject area to implement the Laboratory Space Manager initiative. Implementation of this concept has been a valuable enhancement to work control processes in support of R&D activities. Under this model, a group employee acts on behalf of the Group Leader to oversee activities and operations in assigned laboratory/experimental spaces to help assure that hazards are identified and controlled and that

the space is maintained in a clean and orderly manner. Staff in this role provide leadership in these areas of responsibility and act as role models for workers in their assigned spaces.

1.1.3 Science and Technology Peer Review

Assessments of line organizations throughout the year – including those performed by the Audit and Assessment Directorate's Oversight and Assessment Services – have identified peer review processes utilized by technical organizations as a strong, integral component of the overall assessment effort that supports R&D programs, science and technology activities, and user facility performance. From this perspective, peer review is utilized as an extremely effective performance management tool that is independent, comprehensive, and highly credible. Assessment results associated with science and technology peer review processes included the recommendation that organizations identify ways to adapt these processes so that they can be used to review the effectiveness of ES&H activities and operations conducted in support of research and development.

1.1.4 External Customer Focus and Effective Communication

The Laboratory continues to field highly successful R&D programs in support of the DOE Office of Science, Office of Energy Efficiency and Renewable Energy, Office of Nuclear Energy, and other DOE offices. ORNL has the largest market share of Office of Science research, and is among the leaders in Energy Efficiency and Renewable Energy. Our success has much to do with our customer focus. Information concerning customer focus and feedback from sponsors is received through a number of routes including program reviews; formal customer feedback mechanisms such as surveys, and internal assessment activities; and direct interaction with sponsors on a sometimes daily basis. An analysis of these various sources indicates that ORNL's R&D programs maintain and convey a strong customer feedback ethic and that the information received from customers is viewed as a component of line organization performance assessment information and utilized as direct input to performance improvement. It is evident that our programs maintain close, effective working relationships with sponsors, and that the communications are two-way. We provide our customers with frequent feedback concerning our performance, we are effective in eliciting feedback from them, and we use the information we receive to make impactful improvements and assure our customers that we are listening.

1.1.5 Maturation of S&T Work Planning and Control

The Work/Project Planning and Control Management System (WPPC) provides ORNL staff with the tools needed to organize, manage, control, and plan projects to meet customer objectives, analyze the ES&H hazards, and efficiently complete work. The processes and requirements within WPPC apply to research and development work activities, as well as work activities involving the design, operation, maintenance, modification, construction, demolition, and decommissioning of facilities or systems. Our S&T organizations own, and are responsible for, the WPPC procedure and processes associated with planning and controlling experiments and laboratory work. The processes and tools in this procedure provide the means for all organizations conducting experiments and other work in laboratory settings to establish a graded approach to determine the level of rigor used in the conduct, documentation, hazard analysis, and review of their experiments.

In addition to implementation of the Space Manager Program, our S&T staff undertook a number of additional activities to enhance work planning and control for research projects. In addition to improvements to procedural processes and tools, a top priority was to track the status in completing the required annual update of all ORNL RSSs. The status of over 700 RSSs currently active in the system was tracked weekly with progress regularly reported to Laboratory management.

As a part of ORNL's management system maturity evaluation process, the R&D portion of the Work Control subject area was assessed during August and September by an external peer review team. This external review followed a comprehensive review by an internal team made up of S&T staff including members of the WPPC management system working group. The maturity assessment identified four major recommendations, ten items to be considered by the management system working group, and six recommendations to be referred to other management systems. Corrective actions resulting from this assessment have been entered and will be tracked in the ATS.

1.2 Laboratory Operations and ES&H

1.2.1 Modernization Projects Recognition

ORNL's private sector facilities achieved the prestigious Leadership in Energy and Environmental Design (LEED) certification, the first buildings in the State of Tennessee to achieve this designation. The LEED Green Building Rating System is a voluntary, consensus-based national standard for developing high-performance, sustainable buildings across the United States. In addition, ORNL recently received a Green Construction Award from the Associated Builders and Contractors, a major construction industry association. The Laboratory for Comparative and Functional Genomics (LCFG) Project (a.k.a. the Mouse House) was awarded the DOE Secretary's Acquisition Improvement Award in August. Additionally, three staff members of the Facility Development Division's Facility Design group achieved LEED-accredited design professional status this year.

1.2.2 Environmental Management Accreditation

ORNL achieved ISO 14001 registration for its Environmental Management System as a tool to manage, control, and measure environmental impacts. The ISO 14001 EMS is designed to help improve environmental performance, ensure compliance with regulations and other requirements, improve effectiveness and efficiency, reduce costs, and earn and retain regulator and community trust. The scope of the ISO 14001 EMS includes all UT-Battelle activities that take place at ORNL.

1.2.3 Critique Process Improvements

As the last fiscal year commenced, numerous indications provided evidence that the internal requirements, processes, tools, and training associated with the critique function did not provide the rigor to meet ORNL management expectations for timely identification and correction of adverse conditions. Strong Leadership Team support for upgrades to the critique function resulted in a number of improvements including:

- Establishment of the Critique Pilot position to oversee initial process upgrades and impose a higher level of rigor on the associated procedures, processes, and training used to conduct future critiques,
- Definition of clear expectations that the conduct, effectiveness, completeness, and timeliness of critiques would be fully owned by line management as a component of self-assessment,
- Establishment of a core cadre of critique facilitators through a formal, focused qualification process, and
- Effective and consistent use of the causal analysis, corrective action, and lessons learned functions to ensure that the source of problems is fully analyzed and identified, that corrective actions address root causes, which the long-term effectiveness of corrective actions is verified, and that information useful to the Laboratory is consistently disseminated.

The body of evidence resulting from the conduct of critiques during FY 2004 indicates that the improvements have been effective in raising the rigor of the process, the awareness of line and staff concerning the need for timely, in-depth examination of the fundamental causes of significant problems, and the quality of information provided to Laboratory management concerning significant areas for improvement.

1.2.4 Operational and Environmental, Safety, and Health Support

A number of support organizational initiatives have collectively enabled achievement of new levels of operational excellence throughout the Laboratory this year. We have targeted significant resources in pursuit of building and leading a culture of personal accountability for safety and operational discipline. Management systems continue in their quest to establish, communicate, and maintain well-defined standards, requirements, and tools that integrate safety into all phases of research and operations. Through deployment of SBMS, staff members are getting the instructions necessary to carry out their work safely. We are modernizing ORNL facilities and reducing hazards and legacy materials to create safer work spaces. This conclusion is supported by the preponderance of evidence from our own performance assessment results. The traditional lagging safety, health, and environmental metrics indicate continued significant improvement providing evidence that staff behavior patterns have been changed. Tons of legacy materials have been dispositioned and removed; old buildings have been demolished and new ones built in their place. More importantly, however, we have obtained external validation of our outstanding operational and ES&H performance. During this summer's visit, the DOE-HQ OA-40 Team validated the functionality of our Integrated Safety Management (ISM) Program. Our Occupational Medicine Program once again received AAAHC and CLIA recertification. Our environmental program achieved 14001 registration. Additionally, our Metrology Program achieved 17025 accreditation, a step beyond registration because it required successful performance testing as judged by NIST. In summary, our support organizations have embraced and continue to effectively address the multiple challenges of providing an operational and ES&H infrastructure dedicated to our world-class research and development customers.

1.2.5 Performance Assessment as a Management Tool

The series of O&AS reviews of ORNL line organizations' performance assessment programs continued for a fourth year and showed continuing improvement and maturation across the Laboratory. Each year the criteria have been elevated from the previous year. In FY 2004, overwhelming emphasis was placed on issues associated with using the knowledge we gain through our assessments as input to process improvement initiatives. The compiled results of these reviews indicate that performance has continued to improve. This demonstrates that a culture of continuous improvement is becoming part of the operating philosophy at the Laboratory and is driving improvements in our operations. We are beginning to see organizations use the results of performance assessment activities as input to mid-course corrections, strategic planning, resource allocation, and goal-setting activities.

1.3 Community Service

1.3.1 Expanding Media Coverage

The Communications and Community Outreach Directorate (CCO) has generated support for the Laboratory Agenda by providing media and other external stakeholders with timely and accurate information during the current fiscal year. Key highlights include hosting the 2003 Council for Advancement of Science Writers; coordinating the visit of President Bush and international media; and promoting ORNL by facilitating, as of August 30, 549 television stories, 427 national/international print

stories, 424 regional print stories, and 200 stories in trade journals. In addition, the CCO provided major communication contributions on two occasions to the activation of the DOE Joint Information Center.

1.3.2 Enhancing Community Outreach

ORNL has implemented a robust program of community outreach through a number of avenues. We played a leading role in a successful effort to secure \$55M in funding to renovate Oak Ridge High School, including a \$2M gift from UT-Battelle. Twenty-four Team UT-Battelle volunteer projects were organized within surrounding communities. The Laboratory conducted a community forum for the Director to inform stakeholders about ORNL's agenda. In addition, community outreach projects were funded with approximately \$874,000; projects included the Oak Ridge Rowing Association and the Oak Ridge Arts Council. Also scheduled were 148 presentations through the ORNL Speakers Bureau.

1.3.3 Internal Benefits of Enhanced Communications and Community Outreach

A number of actions by UT-Battelle in the area of communications and community outreach have resulted in enhanced services to the Laboratory's research staff while lowering associated costs. Examples of the benefits obtained through these efforts include:

- Secured \$7.6M in State funding for the Joint Institute for Biological Sciences.
- Secured approval from the State Building Commission for redesign and relocation of the Joint Institute for Biological Sciences.
- Drafted and designed a 32-page brochure for Computing and Computational Sciences, reducing an estimated 15-week project to three weeks.
- Saved the Laboratory more than \$1M through a partnership with the UT Library, while tripling the number of scientific journals available to ORNL researchers.
- Successfully merged the Life Sciences and Fusion Energy libraries, formerly located at the Y-12 Plant, into the ORNL central library with a 17% reduction in space costs.
- Acquired a new \$250K Integrated Library System for the central library with existing resources.
- Maintained full library services while undergoing a substantial renovation effort.
- Maintained graphic support services with a reduced FY 2004 organizational burden and fewer staff.
- Secured Government Printing Office approval for "direct deal" contracts to improve printing services.

All of these accomplishments were achieved while returning a budgetary positive variance of greater than \$100K and while winning multiple regional and national awards for ORNL publications.

2. KEY AREAS FOR IMPROVEMENT

2.1 Science and Technology

2.1.1 Integrated Safety Management in the R&D Workplace

The DOE Inspection of ES&H Management at ORNL in July noted significant improvements associated with Integrated Safety Management and R&D Work Control. The results of this review also pointed to the need for continuing management attention to ensure progress in these areas, particularly in maturing R&D Work Control at the bench level and maturing the Laboratory Space Manager program. Definitive improvement areas were identified and are being addressed for the R&D Work Control and Laboratory Space Manager programs.

2.1.2 Strategic Hiring and Diversity

The Laboratory continues to be challenged to place significant emphasis in the area of strategic hiring, as well as overall hiring, and to meet diversity goals and needs. Recruiting and attracting employees with strategic skills is a challenge, including the desire to broaden the diversity component of the workforce. With more than 30% of UT-Battelle's workforce becoming eligible for retirement by 2006, there is the potential for a significant experience drain within a short period of time. Demographically, the vast majority of staff is in the age range of 40–59 years old. As employees elect to retire, we must buttress our efforts to ensure that we effectively recruit staff to allow for a smooth transfer of knowledge, and to effectively manage staffing levels, to maintain a highly skilled and productive workforce. During FY 2004, we continued a multiyear program of strategic hiring to bring to the Laboratory new and innovative research leadership important to our future. In addition, attention must continue to be given to the general hiring program to ensure that we take this opportunity to replenish the Laboratory with the right set of skills for coming decades and to enhance the diversity component in various job classifications.

2.1.3 Peer Review to Assess Operational Support

ORNL's peer review processes play a vital role as a strong, comprehensive, and credible component of each R&D organization's performance assessment program. Peer review activities are utilized to evaluate the vitality of our diverse research and development program efforts, the quality of our science and technology results, and the relevance, unique attributes, and customer perceptions associated with our user facilities. These processes have been highly effective in providing unbiased information to ensure that our technical pursuits maintain the high standards demanded of a world-class research organization. Our research organizations should consider the expansion of the application of peer review concepts to assess mission support elements including operations; environment, safety, and health; and management systems. The success of our research programs is built upon a strong melding of our diverse science and technology expertise with the site entities that represent facility infrastructure, ES&H risk evaluation and management, procurement, and the many other functions that can affect the success of our work. Using tested peer review processes to determine the strength of the efforts of these entities will benefit R&D organizations and their supporting elements in achieving the synergy necessary to advance the goals of the Laboratory Agenda.

2.1.4 Science and Technology Performance Assessment Results

A long-term challenge to R&D organizations is to effectively measure the performance of science and technology programs. Just as other research entities do, we use several forms of programmatic peer review to yield an assessment of how our research is rated on the world scene. ORNL organizations and programs use advisory committees and other independent, knowledge-based evaluative mechanisms, to determine how we are doing with respect to our sponsors' technical pursuits.

Programmatic and organizational reviews that are conducted each year by our sponsors provide valuable information on the quality of our R&D from an independent, yet informed perspective. While the Associate Laboratory Directors use the information from these various reviews to shape their performance assessments and strategic planning, we have not utilized the diverse range of peer review results in a centrally targeted fashion to look for overall S&T strengths or weaknesses of the Laboratory. We would benefit from collecting and analyzing these results from within programs and divisions, from the standpoint of customer communication and needed changes in Laboratory direction. This information, systematically compiled with the yearly information provided by our customers through DOE end-of-year office surveys, would provide a solid body of data for identifying Laboratory-wide strengths, areas for improvement, and internal benchmarks worthy of emulation by organizations looking to improve S&T performance.

In addition to external peer review, we need to continue to optimize our approach for collecting the research accomplishments of the Laboratory as another measure of our scientific and technological productivity. Each research division collects data concerning publications and invited presentations, but the process for entering these data into the ORNL central database is less-than consistent. This makes it difficult for central Laboratory planners and managers to gauge our performance on the world scene and demonstrate to our customers our productivity as a Laboratory.

2.2 Laboratory Operations and ES&H

2.2.1 Nuclear Facilities Budgetary Shortfalls

UT-Battelle is continuing to work aggressively, despite limited direct funding, to improve the material condition, safety, and operational discipline in ORNL nuclear facilities. The actions taken to achieve these improvements has been funded mainly through the reprioritization of existing overhead accounts and the generation of new overhead resources such as the Laboratory's Institutional General Plant Projects (IGGP) Program and Legacy Tax. Despite these aggressive moves on UT-Battelle's part, a significant funding shortfall continues to exist and will threaten not only the improvements that have been made, but ultimately the ability to operate ORNL facilities in accordance with UT-Battelle and DOE expectations. The current footprint of nuclear facilities requires approximately \$40M annually to meet operations, maintenance, and mission needs. Current program funding has provided approximately \$30M annually, resulting in an annual shortfall of just over \$10M. In addition, this shortfall does not include any capital funding for investment or improvement of aging infrastructure. A reduction in the overall footprint of our nuclear facilities will provide a partial solution and allow redirection of available funds to the remaining facilities.

2.2.2 Maintenance and Operations Work Planning and Control

Maintenance and operations work planning and control implementation will require continued management attention. Assessment results and periodic events consistently point to the need for more effective implementation of work control processes. Pertinent FY 2004 assessments included management self assessments, external reviews conducted by independent operations expertise, assessments conducted by the Laboratory's Oversight and Assessment Services organization, and the DOE Inspection of Environment, Safety, and Health Management at Oak Ridge National Laboratory. This challenge and its ramifications were reinforced by the near-miss event which resulted from the dropping of a large hoist from its rail. The associated investigation identified and amplified the message concerning work control implementation deficiencies found during assessments. Improvements are currently being implemented including clarifying work planning roles and responsibilities, revising our work planning and control procedures, and revamping work control training to ensure that it is formulated and targeted to obtain and incorporate past lessons learned. Satisfactory staffing for critical elements of work planning and control activities has been identified as a significant challenge by Laboratory operations organizations.

2.2.3 Facilities and Infrastructure Revitalization

Facilities and infrastructure revitalization remains a fundamental issue; much of our physical plant simply will not support modern research. Outdated and inadequate facilities are, in many cases, incapable of meeting functional requirements, increased safety and operational risks, and expectations for the cost-efficiencies necessary for adequate operations and maintenance. The challenge posed by inadequate facilities also presents a barrier to the recruitment and retention of outstanding research staff. Sustained facilities and infrastructure renewal investment is needed for at least a decade to bring core research facilities and infrastructure to full mission readiness, reduce safety and operational risks, and support

recruiting of outstanding researchers. While significant progress has been made over the past three years, there remains a significant backlog of modernization needs that can only be addressed through direct capital equipment or capital construction funding.

2.2.4 Unfunded Legacy Vulnerabilities

ORNL legacy vulnerabilities are adversely affecting operational cost and safety, and may, in some cases, threaten our compliance status. ORNL continues to face a substantial and costly effort to eliminate legacy vulnerabilities that pose a hazard to workers or impede facility revitalization. A comprehensive summary of these vulnerabilities presents a challenging scenario.

- The actual cost for the disposition of excess materials both within and outside DOE Office of Science (SC) facilities is estimated to be approximately \$81M through FY 2012.
- Decontamination and decommissioning (D&D) of excess facilities will require an average of \$15M per year. The amount required over the next 10 years will be higher due to the backlog of facilities awaiting D&D that were not transferred to the DOE Office of Environmental Management (EM) and have not been funded by SC. Failure to fund the D&D of these facilities will significantly impede the Laboratory's revitalization effort.
- Potential transfer of remediation, long term stewardship, and external regulation responsibilities to the Office of Science that are currently the responsibility of the Office of Environmental Management (EM) will require approximately \$1M per year while EM is performing remediation activities at ORNL and \$10M per year after the EM mission is complete in approximately 2015.
- The maintenance of the 9204-3 (Beta-3) facility at the Y-12 Plant in operable standby mode is continuing to generate escalating legacy costs and represents an environmental vulnerability for DOE. The current capability that exists in Beta-3 for isotope production is expensive to maintain, inefficient, and excessive to mission needs.

These vulnerabilities are not currently reflected in either the SC or EM funding baselines and corrective actions will present both funding and staffing challenges at ORNL. Efforts need to be expanded to provide better estimates of the scope, schedule, and cost of the remediation, maintenance, and stewardship actions that are not covered in the DOE EM or SC baselines and to control the resultant impact to both SC and UT-Battelle.

2.2.5 High Flux Isotope Reactor Infrastructure Upgrades

The need for additional funds to develop and implement infrastructure upgrades at HFIR is evident. Many of the issues identified through the Laboratory's Occurrence Reporting process, related operating experience indicators, and results from the Research Reactors Division performance assessment program consistently point to aging equipment issues associated with the 38-year-old reactor and its support systems. These issues are to be expected at current funding levels and will escalate as the infrastructure ages, if not addressed. In addition, increased costs for HFIR fuel fabrication and spent fuel disposition are anticipated.

2.2.6 Performance Assessment Maturity

The need to continue to develop performance assessment as a key business planning mechanism will remain an area for improvement in FY 2005. While our performance assessment approach and deployment efforts have undergone substantial improvement, the need to ensure the maturity and consistency of the feedback and improvement processes within our organizations is evident in the results of our assessment activities. In support of this goal of maturing our assessment efforts, the PBMS needs

to enhance efforts to describe, define, and provide expertise concerning appropriate metrics and associated assessment processes, tools, and methods that are relevant to R&D and support organization strategic planning activities. Until organizations make full use of the results of their assessment activities as effective inputs to resource allocation decisions and goal-setting activities, our performance assessment processes will remain a less-than optimum link in the business planning chain.

2.3 Community Service

No distinct areas for improvement were identified for the community service component during FY 2004.

APPENDIX A, SCORING TABLES

DETAILS AND RESULTS OF THE FY 2004 PERFORMANCE EVALUATION PLAN SCORING

Projected FY 2004 End of Year Status

Critical Outcome	Value Points	Adjectival Rating	Objective Weight	Weighted Value Points	Available Fee (\$K)	Percent of Fee Earned	Earned Fee (\$K)
1. Excellence in Science and Technology	3.57	Outstanding	60.00%	2.14	\$4,116	100%	\$4,116.00
2. Excellence in Operations and ES&H	3.39	Excellent	35.00%	1.19	\$2,401	90%	\$2,160.90
3. Excellence in Community Service	3.85	Outstanding	5.00%	0.19	\$343	100%	\$343.00
			Total Value Points	3.52			\$6,619.90

Overall Laboratory Rating: OUTSTANDING

Adjectival Rating	Value Points	Percent of Fee Earned
Outstanding	> 3.5	100%
Excellent	$3.5 \geq P > 2.6$	90%
Good	$2.6 \geq P > 1.6$	50%
Marginal	≤ 1.6	0%

ELEMENT	Value Points	Adjectival Rating	Measure Weight	Weighted Score
Critical Outcome 1 We will deliver scientific advances and technological innovations that support DOE missions, apply our expertise and capabilities to the needs of other customers, and sustain and enhance ORNL's distinctive capabilities				
Performance Measures 1.1–1.4 Continued Scientific Excellence, provided by DOE	3.51	Outstanding	66.67%	2.34
Performance Measure 1.5 Deliver SNS	3.58	Outstanding	25.00%	0.90
Performance Measure 1.6 New Research Initiatives	4.00	Outstanding	8.33%	0.33
		Critical Outcome 1 Total		3.57

ELEMENT	Value Points	Adjectival Rating	Indicator Weight	Weighted Score
Performance Measure 1.5 Deliver SNS				
Performance Indicators				
1.5.1 Deliver SNS on Schedule	4.00	Outstanding	20.00%	0.80
1.5.2 Deliver SNS on Budget	3.00	Excellent	30.00%	0.90
1.5.3 Technical and Managerial Performance for SNS	3.75	Outstanding	50.00%	1.88
		Performance Measure 1.5 Total		3.58

ELEMENT	Value Points	Adjectival Rating	Indicator Weight	Weighted Score
Performance Measure 1.6 New Research Initiatives				
Performance Indicators				
1.6.1 New Research Initiative Composite	4.00	Outstanding	100.00%	4.00
		Performance Measure 1.6 Total		4.00

ELEMENT	Value Points	Adjectival Rating	Measure Weight	Weighted Score
Critical Outcome 2 We will sustain and improve ORNL's ability to serve the needs of DOE and the nation through responsible stewardship				
Performance Measure 2.1 Facilities Modernization	3.91	Outstanding	25.71%	1.01
Performance Measure 2.2 Operational Discipline	3.27	Excellent	50.00%	1.64
Performance Measure 2.3 Maximizing Research Effectiveness	2.95	Excellent	12.86%	0.38
Performance Measure 2.4 Legacy Issues	3.17	Excellent	11.43%	0.36
	Critical Outcome 2 Total			3.39

ELEMENT	Value Points	Adjectival Rating	Indicator Weight	Weighted Score
Performance Measure 2.1 Facilities Modernization				
Performance Indicators				
2.1.1 Facilities Revitalization Program (FRP) Composite	3.75	Outstanding	33.34%?	1.25
2.1.2 Deactivate, remove excess equipment and/or prepare facilities to transfer to non-SC programs	4.00	Outstanding	22.22%	0.89
2.1.3 Personnel and Equipment Move Composite	4.00	Outstanding	33.33%	1.33
2.1.4 Maintenance Metric	4.00	Outstanding	11.11%	0.44
	Performance Goal 2.1 Total			3.91

ELEMENT	Value Points	Adjectival Rating	Indicator Weight	Weighted Score
Performance Measure 2.2 Operational Discipline				
Performance Indicators				
2.2.1 Safety and Health Composite	3.00	Excellent	40.00%	1.20
2.2.2 Environmental Composite	4.00	Outstanding	22.86%	0.91
2.2.3 Performance Based Management (PBM) Composite	3.01	Excellent	22.86%	0.69
2.2.4 User Facility Operability/Reliability Composite	3.11	Excellent	11.43%	0.36
2.2.5 Integrated Safety Management (ISM) Maturity Evaluation	4.00	Outstanding	2.86%	0.11
Performance Measure 2.2 Total				3.27

ELEMENT	Value Points	Adjectival Rating	Indicator Weight	Weighted Score
Performance Measure 2.3 Maximizing Research Effectiveness				
Performance Indicators				
2.3.1 Demonstrate responsible cost management performance through the improvement in the Core Composite Rate (CCR)	4.00	Outstanding	66.67%	2.67
2.3.2 Managing Diversity	0.85	Marginal	33.33%	0.28
Performance Measure 2.3 Total				2.95

ELEMENT	Value Points	Adjectival Rating	Indicator Weight	Weighted Score
Performance Measure 2.4 Legacy Issues				
Performance Indicators				
2.4.1 Complete the FY 2004 actions required to implement the liquid and gaseous waste system modernization on the schedule described in the ORNL Liquid and Gaseous Waste Treatment Strategic Plan (ORNL/TM-2003/197).	4.00	Outstanding	50.00%	2.00
2.4.2 Hot Cell Consolidation.	2.33	Good	50.00%	1.17
Performance Measure 2.4 Total				3.17

ELEMENT	Value Points	Adjectival Rating	Measure Weight	Weighted Score
Critical Outcome 3 ORNL will be viewed by its neighbors as a highly valued partner in the region. We will be active participants in economic development, efforts to strengthen science and math education, and support of the community's civic and cultural activities.				
Performance Measure 3.1 ORNL will be recognized within the region as a good corporate citizen	4.00	Outstanding	40.00%	1.60
Performance Measure 3.2 ORNL will encourage the growth of businesses based on ORNL technology and/or resources to enhance the economy	3.75	Outstanding	60.00%	2.25
Critical Outcome 3 Total				3.85

ELEMENT	Value Points	Adjectival Rating	Indicator Weight	Weighted Score
Performance Measure 3.1 ORNL will be recognized within the region as a good corporate citizen.				
Performance Indicators				
3.1.1 UT-Battelle will enhance the Laboratory's role as a valued corporate partner by supporting science education and being a leading participant in major civic endeavors (composite).	4.00	Outstanding	100.00%	4.00
Performance Goal 3.1 Total				4.00

ELEMENT	Value Points	Adjectival Rating	Indicator Weight	Weighted Score
Performance Measure 3.2 ORNL will encourage the growth of businesses based on ORNL technology and/or resources to enhance the economy.				
Performance Indicators				
3.2.1 Indicators of Technology Transfer and Economic Development (TTED) performance	3.75	Outstanding	100.00%	3.75
Performance Measure 3.2 Total				3.75

